Southern California Association of Governments GOODS MOVEMENT TRUCK COUNT STUDY

September 25, 2002

Prepared for:

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ASSOCIATION of GOVERNMENTS

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INTRODUCTION

The Southern California Association of Governments (SCAG) region has recognized that efficient freight transportation is a significant factor in the economic health of the Southern California region. SCAG has included critical goods movement freight projects in the Regional Transportation Plan (RTP) for almost a decade. Trucking provides one of the fastest and most reliable means of getting goods delivered and trucking is perhaps the only feasible mode for intra-regional movements. But trucks are subject to many of the same congestion problems that face all transportation modes in the region and also contribute to them. In addition, as truck traffic grows, especially the use of the largest heavy-duty trucks, attention will increasingly focus on truck safety issues.

In order to understand the magnitude of these problems, the locations where they occur, and to evaluate how alternative solutions might improve the freight transportation system, SCAG needs good data on truck activity. Yet despite the significance of truck issues in the region, the available truck activity data are actually quite limited. The only systematic truck count program in the region is conducted by Caltrans on the state highways. Unfortunately, there are a number of issues associated with the Caltrans truck counts that require supplementary information in order to meet regional truck planning needs (reference Chapter 2).

A major initiative undertaken by SCAG between 1997 and 1999 was the development of a new regional heavy-duty truck travel demand model. The truck model was developed to enable SCAG to project future truck traffic patterns, to evaluate alternatives to improve freight transportation efficiency (such as, a series of proposed truck-only lanes), and to conduct more accurate air quality and conformity analyses.

The truck model was developed with two distinct approaches to estimating truck trip generation and distribution: an “external model” and an “internal model”. The “external model” (truck trips with one or both trip ends outside of the region) estimates truck trip generation and distribution using a commodity flow database. The “internal model” estimates truck trip generation and distribution using more traditional methods. In both the external and internal models, the original limitations associated with the vast array of input data has always been a concern of SCAG staff. It would be desirable to collect additional data to validate commodity flows, origin and destination patterns, payload factors, time of day factors, trip generation rates, and gravity model parameters.

Project Goals

This study was conducted in order to begin resolving the data needs described in the report. The main project goals were to:

- Develop a comprehensive truck count database
- Conduct and document counts that have data reliability
- Develop a program for an on-going truck monitoring program
- Supplement and expand the existing truck count data and fill in gaps
- Facilitate refinement of the SCAG Truck Model
- Provide data on truck volumes by classification and land use
- Verify and improve knowledge of truck travel patterns and truck trips serving intermodal facilities and regional gateways
- Furnish annual and weekday truck traffic for modeling purposes and provide a base of information that will be useful for regional freight movement studies

Project Advisory Committee

A mailing list of over eighty (80) people was developed to provide regional oversight to project staff. The Project Advisory Committee held monthly to bi-monthly meetings to help establish survey questionnaires, survey methodology, and analysis methodology, reference Chapter 1 for a complete list of member agencies.

EXISTING DATA SOURCES

A number of statewide and regional data sources are available to interested parties and have been outlined in Tables 1a&b. As mentioned previously, although these data sources exist, there are limitations to the data when applied to the SCAG model, some of these issues have been identified in the tables.

Table 1a Truck Classification Counts

Source	Type of Data	Date of Data	Limitations of Data
Caltrans Classification Counts	Annual Average Daily Traffic (AADT) counts taken on all State Highways.	Counts taken on 6-year rotating basis.	• Many sites lapse due to lack of resources. • Many sites are estimated. • Little known about day of week or seasonal variations in truck traffic and its relationship to AADT. • Do not provide information on temporal truck patterns.

			V Counts are only on the State Highway System.
Sub-regional Studies: *Gateway Cities* *Los Angeles* *Orange County* *South Bay Cities* *Inland Empire* *San Gabriel Valley*	Vary.	Vary.	V Some have examined temporal truck patterns, but overall do not represent a statistically valid sample of sites. V Different collection methods make it difficult to construct a comprehensive regional picture.

Table 1b Survey Data

Source	Type of Data	Date of Data	Limitations of Data
Caltrans Statewide Truck Survey	Roadside intercept survey conducted in seasonal waves at weigh stations and agricultural inspection stations throughout California.	Surveys conducted in 2000.	V Surveys only taken at weigh stations and agricultural inspection stations.
California Air Resources Board (ARB) – Statewide Survey	Statewide study of trucks with on-board global positioning system (GPS) loggers. Collected second-by-second data on speed and location.	Data has not been released by writing of this report.	V Unknown.
California Air Resources Board (ARB) & South Coast Air Quality Management District (SCAQMD) – South Coast Air Basin Survey	Conducted in the South Coast Air Basin, surveyed over 1,000 trucks for general operating patterns and 100-200 trucks equipped with GPS data loggers.	Data has not been released by writing of this report.	V Unknown.

Other Modeling Issues with the Existing Count Data

The following additional issues have been identified regarding the SCAG truck model and with further data may be resolved.

- The SCAG truck model was validated using a series of screenline counts, developed from Caltrans' truck counts. Issues associated with these counts and the missing data on many key arterials suggest that a more comprehensive source of count data might improve the validation of the truck model.

- There are no clear validation criteria for trucks so it was never clear whether the difference between estimated and observed truck AADT was reasonable given natural variations in daily truck traffic.

- Truck traffic in the model was estimated by weight class but validation counts were based on number of axles. The correspondence between axle counts and weight class bears further investigation in order to better understand the implications for interpreting results of weight class analysis with the model.

- The procedure used to allocate AADT to the model's four time periods was accomplished with a series of time of day factors taken from a limited number of 24-hour classification counts. The accuracy of these factors on a regional basis was never established.

Modeling Issues with the Existing Intercept Survey Data

Inputs into the external model used data from a number of vehicle intercept surveys conducted by Caltrans at various external cordon locations in the region during the early 1990s. The intercept surveys were used to estimate payloads by commodity group, to estimate empty fractions and through trip volumes, and to determine the appropriate routings of traffic heading to or from specific external origins and destinations.

Unfortunately, the existing intercept surveys did not include sufficient data to estimate payload factors for all of the commodity groups with a high level of accuracy. These data had to be supplemented with statewide data from the U.S. Truck Inventory and Use Survey (TIUS), now referred to as the Vehicle Inventory and Use Survey (VIUS).

The intercept surveys were also used to estimate the number of empty trucks and the number of through truck trips. The annual truck trip estimates and day-of-the-week distributions of truck traffic taken from weigh-in-motion (WIM) stations were then used to estimate truck average annual daily traffic (AADT) by truck weight class. These external truck trips were then assigned to specific external cordons using truck counts from each cordon. Had sufficient origin-destination data been available for all of the external cordons, this allocation process would have provided far more accurate results. In addition, the external origin-destination (O-D) surveys could have been used to validate the commodity flow information and would have greatly improved the calibration of the model. Unfortunately, only a handful of cordons were surveyed and several of these surveys were out of date.

DATA COLLECTION

Based on the issues with existing data described in Chapter 3, SCAG staff determined the most efficient use of their resources at this time, were to conduct classification counts and external intercept surveys as detailed below. Data can be obtained by contacting SCAG Planning Department staff.

Classification Counts

In the fall of 2001, twenty-four (24) -hour truck classification counts were taken at over 150 locations, reference Table 2. Varying classification methodologies were discussed at the beginning of the project with the Steering Committee to determine the most effective method of collecting truck classification data, reference Appendix A of the report for a detailed description of classification count methodologies. It was determined the most effective method for collecting classification data in this study was by axle (2, 3, 4, and 5 or more).

External Intercept Surveys

Over 3,300 twenty-four (24) -hour intercept surveys were conducted during the month of November 2001 at 10 locations within the SCAG region (reference Table 3). During that same period, classification counts were conducted and used to analyze the data. A training seminar and pilot survey were conducted prior to the November intercept surveys and are described in detail in Chapter 3. Figure 1 identities the questions asked in the intercept survey.

Table 2 Locations for Classification Counts

Location #	Screenline	Count Roadway	Location	Activity Type	County	Milepost
1	1	I-5	S/O Zoo Dr, mp27.	1	LA	27
2	1	I-5	S/O Zoo Dr,	1	LA	27
3	1	SR-2	S/O 134, mpR18.81	1	LA	18.81
4	1	SR-2	S/O 134, mpR18.81	1	LA	18.81
5	1	US-101	S/O Barham Bl, mp	1	LA	9.18
6	1	US-101	S/O Barham Blvd	1	LA	9.18
7	1	I-405	S/O Mulholland Dr	1	LA	37
8	1	I-405	S/O Mulholland Dr	1	LA	37
9	1	SR 134 Off Ramp	W/B TO COLORADO	1	LA	R11.44
10	1	SR 134 On Ramp	E/B TO COLORADO	1	LA	R11.44
11	1	Central Avenue	Betw 134 & Doran	NC	LA	
12	1	SR 27 Topanga Canyon	S/O Ventura Blvd	1	LA	12.25
13	1	San Fernando Road	S/O SR-134	3	LA	
14	1	Cahuenga Blvd West	N/O Mulholland	3	LA	
15	1	Sepulveda	S/O Mulholland Dr	3	LA	
16	2	I-10	E/O 710, mp21.38	1	LA	21.38
17	2	I-10	E/O 710, mp21.38	1	LA	21.38
18	2	SR-60	E/O 710	1	LA	R3.3
19	2	SR-60	E/O 710	1	LA	R3.3
20	2	I-5	E/O 710, mp 13.78	1	LA	13.78
21	2	I-5	E/O 710	1	LA	13.78
22	2	I-105 (ANDERSON FWY)	E/O LONG BEACH FW	1	LA	R13.5
23	2	I-105 (ANDERSON FWY)	E/O LONG BEACH FW	1	LA	R13.5
24	2	SR-91	E/O 710	1	LA	R11.7
25	2	SR-91	E/O 710	1	LA	R11.7
26	2	I-405	E/O 710, mp7.60	1	LA	7.6
27	2	I-405	E/O 710, mp7.60	1	LA	7.6
28	2	7TH STREET	XING LA RIVER	3	LA	
29	2	VALLEY BLVD	E/O Westmont	3	LA	
30	2	WASHINGTON BLVD	Betw 710 & Atlant	3	LA	
31	2	ATLANTIC AVENUE	N/O Bandini	3	LA	
32	2	BANDINI BLVD	E/O Atlantic	3	LA	
33	2	SLAUSON AVENUE	E/O 710	3	LA	
34	2	FLORENCE	W/O EAstern Av	3	LA	
35	2	SR 42/105-FIRESTONE	W/O Garfield	1	LA	R13.67
36	2	SR-1	W/O Magnolia, mp7	1	LA	7
37	2	OCEAN BLVD	E/O Golden Avenue	3	LA	
38	3	I-110	N/O El Segundo Bl	1	LA	13.4
39	3	I-110	N/O El Segundo Bl	1	LA	13.4
40	3	I-710	N/O Rosecrans	1	LA	14.97
41	3	I-710	N/O Rosecrans	1	LA	14.97
42	3	I-405, MP20.22	N/O Rosecrans	1	LA	20.22
43	3	I-405	N/O Rosecrans	1	LA	20.22
44	3	CENTRAL	N/O 120th St	3	LA	
45	3	CRENSHAW Bl	N/O 120th St	3	LA	
46	3	SR 1-SEPULVEDA, MP24.	N/O Rosecrans	1	LA	24
47	3	EL SEGUNDO BL	W/O I-405	3	LA	

Table 2 (cont.) Locations for Classification Counts

Location #	Screenline	Count Roadway	Location	Activity Type	County	Milepost
48	4	SR 57 (Orange Fwy)	N/O ORANGEWOOD INT	1	OR	11.9
49	4	SR 57 (Orange Fwy)	N/O ORANGEWOOD INT	1	OR	11.9
50	4	SR 91	E/O of Tustin Av	1	OR	8.5
51	4	SR 91	E/O of Tustin Av	1	OR	8.5
52	4	I-5 Santa Ana FWY	S/O Chapman	1	OR	34.8
53	4	I-5 Santa Ana FWY	S/O Chapman	1	OR	34.8
54	4	SR 22 (Garden Grove Fwy)	E/O The City Driv	1	OR	R9.8
55	4	SR 22 (Garden Grove Fwy)	E/O The City Driv	1	OR	R9.8
56	4	I-405	Betw Euclid & Harbor	1	OR	12.05
57	4	I-405	Betw Euclid & Harbor	1	OR	12.05
58	4	LAKEVIEW AVE	Betw La Palma/Mck	3	OR	12.83
59	4	SR 90-IMPERIAL HWY	N/O 91	1	OR	12.83
60	4	GLASSELL ST	S/O 91	3	OR	
61	4	LINCOLN AVE	West of Santa R.	3	OR	
62	4	TAFT	W/O Main St	3	OR	
63	4	KATELLA	W/O Main St	3	OR	
64	4	CHAPMAN	W/O SR 57	3	OR	
65	4	FAIRVIEW	S/O 17th St	3	OR	
66	4	WARNER AVE	W/O Harbor Bl	3	OR	
67	4	VICTORIA ST	E/O Brookhurst	3	OR	
68	4	SR-1	E/O Brookhurst	1	OR	22.05
69	5	I-5	N/O Artesia Av	1	OR	44.3
70	5	I-5	N/O Artesia Av	1	OR	44.3
71	5	SR 57 (Orange Fwy)	N/O Tonner Cyn Rd	1	OR	21.8
72	5	SR 57 (Orange Fwy)	N/O Tonner Cyn Rd	1	OR	21.8
73	5	SR 91 (Artesia Fwy)	W/O Orangethorpe	1	OR	R.49
74	5	SR 91 (Artesia Fwy)	W/O Orangethorpe	1	OR	R.49
75	5	I-405	E/O Jct. Rt. 22 West	1	OR	23.3
76	5	I-405	E/O Jct. Rt. 22 West	1	OR	23.3
77	5	OLD RANCH ON RAMP	ON RAMP I 405	3	OR	
78	5	ROSECRANS AVE	W/O Beach Bl	3	OR	
79	5	LA MIRADA BLVD	W/O Beach Bl	3	OR	
80	5	ARTESIA BL	W/O I-5	3	LA	
81	5	SR 1	S/O Westminster	1	OR	0.99
82	5	SR 142 (Carbon Cyn)	E/O Valencia Ave	1	OR	1.8
83	5	Harbor Blvd	N/O Whittier Bl	3	OR	
84	5	SR 72-WHITTIER BLVD	W/O Beach Bl	1	OR	11.4
85	5	TONNER CYN RD (MINOR	N/O Valecia	NC	OR	
86	5	SR-90 (Imperial Hwy)	W/O Beach Bl	1	OR	0.48
87	5	VALLEY VIEW	S/O Artesia Bl	3	LA	
88	5	Carson/LINCOLN	E/O Bloomfield	3	OR	
89	5	CERRITOS AVE	W/O Los Alamitos	3	OR	
90	5	WILLOW/KATELLA AVE	E/O I-605	3	LA	

Table 2 (cont.) Locations for Classification Counts

Location #	Screenline	Count Roadway	Location	Activity Type	County	Milepost
91	6	SR-91	Betw SR 71 & Serf	1	SB	R2.9
92	6	SR-91	Betw SR 71 & Serf	1	SB	R2.9
93	6	I-10	Betw Euclid & Cam	1	SB	3.47
94	6	I-10	Betw Euclid & Cam	1	SB	3.47
95	6	SR-60	Betw Euclid & Cam	1	SB	R4.58
96	6	SR-60	Betw Euclid & Cam	1	SB	R4.58
97	6	MISSION BLVD	Betw Euclid and Cam	3	SB	
98	6	RIVERSIDE DR	Betw Euclid and Cam	3	SB	
99	7	I-215 (Riverside Fwy)	Betw I-10 & Wash'	1	SB	3.37
100	7	I-215 (Riverside Fwy)	Betw I-10 & Wash'	1	SB	3.37
101	7	I-15 (Devore Fwy)	S/O I-10	1	SB	2.39
102	7	I-15 (Devore Fwy)	S of I-10	1	SB	2.39
103	7	RIVERSIDE AVE	Betw Slover & I-10	3	SB	
104	7	CEDAR AVE	Betw Slover & I-10	3	SB	
105	7	SIERRA AVE	Betw Slover & I-10	NC	SB	
106	7	MILLIKEN AVE	Betw Brickell & I	1	SB	
107	7	RANCHO AVE	Betw 'N' & I-10	1	SB	
108	7	ETIWANDA AVE	Betw Airport & I-10	1	SB	
109	7	SR 83-EUCLID AVE	S/O Holt	1	SB	9.46
110	7	GROVE AVE	S/O Holt	1	SB	9.46
111	7	HAVEN AVE	Betw Airport Dr & I-10	1	SB	
112	8	I-210	E/O 605	1	LA	R36.41
113	8	I-210	E/O 605	1	LA	R36.41
114	8	I-10	E/O 605	1	LA	31.5
115	8	I-10	E/O 605	1	LA	31.5
116	8	SR-60	W/O Azusa Ave	1	LA	17.97
117	8	SR-60	W/O Azuza Rd	1	LA	17.97
118	8	ARROW HWY	E/O 605	3	LA	
119	8	LIVE OAK AVE	E/O 605	3	LA	
120	8	TEMPLE AVE	N/O Railroad Ave	3	LA	
121	8	HACIENDA BLVD	N/O Valley Bl	3	LA	
122	8	VALLEY BLVD	E/O Stimson Av	NC	LA	
123	8	FULLERTON RD	Harbor Bl	NC	LA	
124	9	SR-60	E/O Moreno Bch Dr	1	RIV	19.12
125	9	SR-60	E/O Moreno Bch Dr	1	RIV	19.12
126	9	SR-30 (7/93)	W/O SR 330	1	SB	R28.66
127	9	SR-30 (7/93)	W/O SR 330	1	SB	R28.66
128	9	I-10	W/O Rte 30	1	SB	29.31
129	9	I-10	W/O Rte 30	1	SB	29.31
130	9	SR 74-PINACATE RD	W/O MENIFEE	1	RIV	29.8
131	9	SAN TIMOTEO CYN RD	N/O Palomares Rd	3	SB	29.8

Table 2 (cont.) Locations for Classification Counts

Location #	Screenline	Count Roadway	Location	Activity Type	County	Milepost
132	10	SR 118	W/O LA/Ventura Co	1	VEN	R32.6
133	10	SR 118	W/O LA/Ventura Co	1	VEN	R32.6
134	10	US 101	E/O Westlake Bl	1	LA	0.7
135	10	US 101	E/O Westlake Bl	1	LA	0.7
136	10	SR 1	W/O LA Co Line	1	VEN	0
137	10	SR 126	W/O LA/Ventura Co	1	VEN	62.87
138	11	US101	E/O Camarillo Spr	1	VEN	10.74
139	11	US101	E/O Camarillo Spr	1	VEN	10.74
140	11	SR 126	W/O Sycamore Rd	1	VEN	16.59
141	11	SR 118-LOS ANGELES AV	E/O Bradley Rd	1	VEN	12.79
142	11	SR 1	At about Pt. Mugu	1	VEN	4.2
143	12	I-10 NORTH BND	E/O GENE AUTRY	1	RIV	36.14
144	12	I-10 SOUTH BND	E/O GENE AUTRY	1	RIV	36.14
145	12	SR 111	E/O GENE AUTRY	1	RIV	T47.8
146	13	I -15	N/O Sr - 138	1	SB	R21.37
147	13	I -15	N/O Sr - 138	1	SB	R21.37
148	13	SR - 138	E/O Sr - 2	1	SB	6.67
149	13	Sr - 18	@ Forest Boundary	1	SB	100.96
150	14	I-110	S/O Sepulveda Blvd	NC	LA	5.45
151	14	I-110	S/O Sepulveda Blvd	NC	LA	5.45
152	14	SR 103	S/O Willow St	NC	LA	
153	14	SR 103	S/O Willow St	NC	LA	
154	14	I-710	S/O Willow St	NC	LA	
155	14	I-710	S/O Willow St	NC	LA	
156	15	I-15	S/O SR 60	1	RIV	51.47
157	15	I-15	S/O SR 60	1	RIV	51.47
158	15	Van Buren Blvd	S/O SR 60	NC	RIV	
159	15	SR 91	S/O SR 60	NC	RIV	
160	15	SR 91	S/O SR 60	NC	RIV	
161	15	I-215	S/O SR 60	1	RIV	43.27
162	15	I-215	S/O SR 60	1	RIV	43.27
163	7	Foothill	Between Euclid/Campus	3	SB	
164	7	Cherry	Between I-10/Valley	3	SB	
165	7	Citrus	Between I-10/Valley	3	SB	

NOTE 1: CALTRANS right-of-way out of traffic, positioned to manually count truck traffic at subject locations.

NOTE 2: Type "3" locations are all on local arterials that do not involve CALTRANS right-of-way encroachment.

NOTE 3: Type "NC" were screenline locations originally identified for classification counts, but will not be counted at this time.

Table 3 External Cordon Station Intercept Locations

Location Number	Count Roadway	SCAG Location	Direction	Specific Site Review Location
1	US 101	Santa Barbara/Ventura County Line	Northbound	NB off ramp at Bates Road
2	US 101	Santa Barbara/Ventura County Line	Southbound	SB off ramp at Bates Road
3	SR 14	Los Angeles/Kern County Line	Northbound	Off ramp at Ave A (Cnty line between Kern and LA Cnty)
4	SR 14	Los Angeles/Kern County Line	Southbound	Off ramp at Ave A (Cnty line between Kern and LA Cnty)
5	SR 58	San Bernardino/Kern County Line	Eastbound	Boron Rest area - W of US395
6	SR 58	San Bernardino/Kern County Line	Westbound	Boron Rest area - W of US395
7	I-15	East of Calico Road	Eastbound	Clyde V. Kane Rest area - between Barstow and Baker
8	I-10	East of Dillon Road (near Indio)	Eastbound	Cactus City Rest area - E of SR 86
9	SR 86	Westmorland, Imperial County	Northbound	Between Martin Road & Lack Street
10	SR 86	Westmorland, Imperial County	Southbound	Between Martin Road & H Street

Figure 1 Intercept Survey Questionnaire

2001 SCAG TRUCK EXTERNAL INTERCEPT SURVEY:
MAIL BACK QUESTIONNAIRE (QUESTION? Call 858/ 566-1766)

SURVEY STAFF ONLY: Date of trip:__________ Time:__________ A.M. / P.M.
Location #:__________ Route #:____________________ Direction:__________

PLEASE ANSWER THE FOLLOWING QUESTIONS:

HAZMAT # ____________________ Registration State (*circle one*): *CALIFORNIA / OTHER*

Vehicle type (*circle one*):

2 Axle Single Unit | 3 Axle Single Unit | 4 or more Axle Single Unit | 3 or more Axle Single Trailer | Multi-Trailer | 2 or 3 Axle Tractor

# of axles (including axles of any trailers): ________ # of trailers:________ Is this a container truck? (*circle one*) *YES / NO*

1. What is the Gross Vehicle Weight (GVW) Rating of the vehicle:____________________
2. Are you currently carrying cargo? (*circle one*) *YES / CURRENTLY EMPTY / NEVER CARRY CARGO*
   2a. If yes, what is the primary commodity on board?____________________
3. What is the weight of the cargo? ____________________ (*circle one*) *LBS. / KILOGRAMS*
4. Where is this vehicle (truck) based? City:____________________ State/Province:__________
5. Where did the truck last stop to load or unload?
   Route & nearest cross street: ____________________ City:__________ State/Province:________
6. Where will the truck stop next to load or unload?
   Route & nearest cross street:____________________ City:__________ State/Province:________
7. In addition, how many other stops will you/did you make in Southern California today (excluding San Diego & Imperial Counties)? __________
8. Is there a specific roadway problem in Southern California where you would like to see improvements?
   ____

ISSUES ADDRESSED IN THE ANALYSIS

The data collection program detailed in Chapter 3 was designed to provide (first and foremost) diagnostic data that can be used to focus resources in the future on those areas of the model improvement that would provide the greatest benefit in terms of regional analysis. Chapter 4 outlines the issues addressed by the study, including:

<u>Truck Counts</u>

- **Truck classification** – describes the approach used to develop axle-count – to-Gross Vehicle Weight (GVW) conversions.
- **Use of Caltrans truck counts as a source for model validation** - describes the characteristics of the Caltrans counts that have potential implications if they are used to calibrate the model and the methodologies of this study.
- **Predictions of arterial volumes** – how this study can be used to provide insight into how effective the model is at assigning trucks to the arterials as compared to freeways and other State highway facilities.
- **Time of day factors –** how the studies hourly counts will be used to examine validity of the time of day factors.
- **Accuracy of the model for analysis of critical facilities and critical truck traffic streams -** how the analysis of the count data developed for this study can provide some insight into the degree of confidence that users of the model can have when conducting studies along critical corridors and for the heaviest classes of trucks.

<u>Intercept Survey Data</u>

- **Effectiveness of the commodity flow technique for modeling external traffic flows** - how study data can be used to compare total tonnage volumes at the external cordons, aggregate commodity distributions, origin-destination patterns, and conversion factors for tonnage to truck trips to determine if the commodity flow approach provides reasonable estimates of traffic volumes at the external cordons.
- **How accurate is Reebie commodity flow data as a primary source for modeling external flows** – details the commodity flow data used in constructing the SCAG external model and how the studies intercept survey data can be used to provide insight into accuracy of Reebie data.
- **Validation of weight allocation across truck classes and truck payload factors by commodity group** – details the process of converting the commodity flow data for modeling from commodity tonnage values into truck trips.

- **Validation of the routing assumptions at the external cordons** – describes how analyzing the O-D patterns from the intercept surveys will make it possible to validate the routing assumptions and make adjustments that would better reflect true routing patterns.
- **Through movements and empty volumes** – details how the surveys from this study can be used in conjunction with other survey data to validate the through factors and the empty factors
- **Time of day factors** - the external intercept survey can be used to verify time of day factors used in the external model to allocate 24-hour truck volumes to the four (4) model periods.

ANALYSIS OF COUNT DATA

The following analysis were conducted and are described in detail in Chapter 5 of the report.

Comparison of VRPA Count Data and WIM Data

WIM data were used extensively in the development of the truck model, and are also used throughout the analysis of the VRPA count and survey data. Chapter 5 describes the comparison of the data and draws the following general conclusions regarding the accuracy of VRPA Count data and WIM equipment:

- Counts of trucks with 5 or more axles are very accurate using either manual or WIM data collection methods;
- Wide discrepancy between the counts for 2-axle trucks is consistent with problems commonly encountered classifying the lighter truck classes; and
- Differences between the manual and WIM counts for the 3-axle and 4-axle imply that detailed analysis of the classification accuracy of WIM equipment for 3-axle and 4-axle trucks could determine whether the WIM equipment overestimates in this vehicle class or if the manual count data underestimates for these trucks.

Comparison of VRPA Count Data and Caltrans Count Data

In addition to collecting WIM data, Caltrans also produces annual estimates of truck volumes at thousands of highway locations throughout the State. There were 28 locations identified as having Caltrans truck counts nearby VRPA truck counts. Chapter 5 details the process of adjusting the VRPA data to compare the two data sets. The report further outlines the comparison of the two data sets by:

- Differences in vehicle classification method;
- Comparisons of VRPA and Caltrans data by axle group;
- Accuracy of Caltrans locations relative to year of last count;
- Actual vs. estimated Caltrans truck volumes.

The following general conclusions are described in detail in Chapter 5.

- 5 or more axles - large percentage differences between the Caltrans data and the VRPA data, however statistical analysis could not demonstrate a statistically significant difference at the 95% confidence level. Considering the high correlation of VRPA and WIM data in this category, this suggests that the Caltrans counts are high relative to the VRPA counts in many locations.

- 2-axle trucks - the Caltrans data are higher than the VRPA data, which is higher than the WIM data. A large part of this difference is the result of different criteria for separating 2-axle trucks from the 2-axle vehicle pool. The Caltrans counts likely include trucks with weight ratings lower than those included in the heavy-duty truck model. The more narrow definition of 2-axle trucks used for the VRPA or WIM data is much more likely to match vehicles relevant to the truck model.

Comparison of using VRPA data to evaluate SCAG Model Data

In the near future, SCAG will be updating the truck model using 2000 Census data. At this time it would be useful to conduct a re-validation of the model. The VRPA data can be used in this re-validation provided certain adjustments to the data are made as described in Chapter 5.

Analysis of Time of Day Factors

Chapter 5 describes the process of comparing VRPA and Caltrans WIM data time of day factors.

ANALYSIS OF INTERCEPT SURVEY DATA

The survey was conducted at 10 locations at or near the external cordon lines for the SCAG region study area. This survey was supplemented by the Caltrans Heavy-Duty Truck Travel Model Survey (CTMS) conducted throughout California in 1999. An additional nine locations (of fifty) for the Caltrans survey were at or near cordon lines for the SCAG study area.

Chapter 6 describes the preparation and analysis of the SCAG intercept survey, as well as the use of the 1999 CTMS survey in the analysis, including:

- **Data preparation and validation** – describes the quality control process to check the validity and reliability of the data, as well as the process to code origin and destination (O-D) information and commodity data.
- **Data validation and editing procedures** – details the internal checks for data consistency that were made to ensure the accuracy of data entry and survey responses.
- **Gross vehicle weight ratings and cargo weights** – describes the process of adjusting weights that were over-reported and the filtering process to determine.
- **Origin and destination problems** – describes the two types of problems with the origin and destination data.
- **Expanding the survey data** – details the process of expanding the survey responses using the count data to represent the entire population of trucks that passed the survey location.
- **Adding the Caltrans Truck Travel Model Survey (CTMS)** – describes the CTMS study purpose and data set, as well as outlines the differences between it and the VRPA data, including:
    - Limitations of the Caltrans data
    - Constructing gross vehicle weight ratings for the CTMS data
    - Expansion Differences for the Caltrans CTMS Survey
    - Seasonal Variations in the Caltrans Data

In addition, the following analysis were conducted and are detailed in Chapter 6:

- **Total Annual Commodity Tonnage and Commodity Distribution** – provides estimates of annual tonnage generated from the VRPA and Caltrans survey data.
- **Distribution of Tonnage by Weight Class** – provides estimates of conversion factors generated from the Caltrans and VRPA survey data.
- **Distribution of Tonnage by Payload Factors** – provides payload factors by weight class from the VRPA data.
- **Analysis of External Routing Assumptions –** provides actual survey routings for each O-D pair in the survey data.
- **Analysis of Time of Day Factors** – shows the time of day factors estimated from the surveys, the data can be used to evaluate time of day factors for external trips.
- **Analysis of Through Trips** – trip tables were developed from the combined VRPA and Caltrans data, the tables can be used to evaluate the through trip assumptions in the model.

- **Analysis of Empty Factors** – empty truck percentages were generated for each of the VRPA and Caltrans survey locations and can be used to assess the empty factors used in the model.

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RECOMMENDATIONS

Chapter 7 of the report documents recommendations for on-going truck data collection and monitoring programs. The results from this study indicate that the SCAG region could benefit from the development of programs and data collection efforts, which are coordinated through member agencies to ensure efficient use of resources and maximize data collection efforts. In addition, recommendations have been made for some one-time data collection programs to address specific needs for model improvements. Table 5 highlights the suggested programs and data collection efforts and the reasons for such effort.

Table 5 On-Going Truck Monitoring and Data Collection Programs

Recommendation	Reason	Methodology
Establish a regular truck count program.	Supplement Caltrans count program to support model development and planning efforts.	V Count state highway facilities on the SCAG regional model screenlines manually on a 6-year rotation, with half counted every three years. V Sample of 36 locations be identified for 24-hour bi-directional counts (conducted on 2 screenlines in each of the three geographic regions – eastern, central, and western and 2 locations each for each facility type – interstate, highway, and arterial). The remainder of the counts be 10-hour counts (2-hours each in AM and PM peak and night, and 4-hour counts in the mid-day. V Conduct partial day counts during each of the 4 SCAG model periods, once each season at each sample location every ten years for daily and seasonal factors. V Currently manual counts seem to be the best option, however SCAG should consider future installation of permanent count stations along screenlines.
Work with the cities and counties to obtain arterial classification counts.	Counts are difficult to come by and many arterials carry significant truck volumes.	V Work with cities to document and obtain arterial counts.
Prepare a guidance document for classification counts in the region.	Provide consistency and efficiency of data throughout region by developing standard methodologies and meet minimum standards for count data.	V Specify definitions of vehicle classifications. V Provide guidance on how to conduct manual and machine counts. V Provide acceptable expansion factors for partial day counts. V Provide guidance on time of day, day of week, and seasonal considerations.

Table 5 (cont.) On-Going Truck Monitoring and Data Collection Programs

Recommendation	Reason	Methodology
Work with the San Bernardino Association of Governments (SANBAG) and Riverside County Transportation Commission (RCTC) to obtain truck classification counts from count monitoring programs.	Provides a current and on-going data source of count data from permanent count stations in San Bernardino and Riverside Counties.	V Contact and work with the agencies to obtain count data and document available counts.
Work with Caltrans and the county transportation agencies to ensure all future corridor studies include classification counts that conform to the specifications developed in the guidance document.	Provide consistency in the region to better utilize resources and reduce redundancy.	V Develop guidance document consistent with Caltrans requirements. V Work with Caltrans and county transportation agencies to encourage the guidance document.
On a one-time basis conduct more in-depth studies of arterial truck activity.	Provide the basis for correcting assignment problems in the model.	V Select several screenlines that include both interstates and arterials, where interstate truck volumes are generally over-estimated and arterial volumes are generally under-estimated. Conduct 24-hour one day counts at all interstate, highway, and arterial facilities cut by the screenline.
Conduct specialized truck speed studies.	Ensure the SCAG Truck Model reflects accurate congested speeds for trucks.	V Some data should be available from existing weigh-in-motion sites. V Data collection should focus on freeways and should examine speeds by lane and by vehicle class.

1. INTRODUCTION

BACKGROUND

Truck activity in the Southern California Association of Governments (SCAG) region is associated with a number of critical regional planning issues. Efficient freight transportation has been recognized in the Regional Transportation Plan (RTP) for almost a decade as a significant factor in the economic health of the region. More freight, by any measure, moves on trucks than any other mode of transportation. Trucking provides one of the fastest and most reliable means of getting goods delivered and trucking is perhaps the only feasible mode for intra-regional movements. Increasing reliance on just-in-time delivery of industrial supplies and the growth of e-commerce places even greater demands on an efficient, reliable, and fast trucking system. But trucks are subject to many of the same congestion problems that face all transportation modes in the region. Truck traffic growth also contributes to regional congestion problems.

There is also growing concern about the contribution of truck emissions to regional air quality problems. As a major source of NO_x emissions, trucking contributes to the regional ozone problem. New particulate matter emission standards will also focus new attention on truck emissions.

As truck traffic grows, especially the use of the largest heavy-duty trucks, attention will increasingly focus on truck safety issues. New hours of service restrictions are the result of public concern about truck safety and truck-auto conflicts abound in the more urbanized portions of the region.

In order to understand the magnitude of these problems, the locations where they occur, and to evaluate how alternative solutions might improve the freight transportation system, SCAG needs good data on truck activity. Yet despite the significance of truck issues in the region, the available truck activity data are actually quite limited. The only systematic truck count program in the region is conducted by Caltrans on the state highways. Unfortunately, there are a number of issues associated with the Caltrans truck counts that require supplementary information in order to meet regional truck planning needs (reference Chapter 2).

A major initiative undertaken by SCAG between 1997 and 1999 was the development of a new regional heavy-duty truck travel demand model. The truck model was developed to enable SCAG to project future truck traffic patterns, to evaluate alternatives to improve freight transportation efficiency (such as, a series of proposed truck-only lanes), and to conduct more accurate air quality and conformity analyses.

The truck model was developed with two distinct approaches to estimating truck trip generation and distribution: an "external model" and an "internal model". The "external model" (truck trips with one or both trip ends outside of the region) estimates truck trip generation and distribution using a commodity flow database. Commodity flows are input to the model in terms of annual tonnage flows. Commodity flow origins and destinations within the region are provided at the county level. These annual tonnage flows must be converted to daily truck traffic volumes for each of the three truck weight classes in the model (the weight classes were chosen to correspond to the three truck gross vehicle weight classes in the California Air Resources Board (ARB's) EMFAC emission model). The first step in this process is to allocate the total tonnage for each commodity to each of the three weight classes (using data from the Census' Vehicle Inventory and Use Survey). The tonnage flows are then converted to truck trips using average truck payload factors for each commodity group. The payload factors were developed on a regional basis using data from a series of roadside intercept surveys conducted by or under sponsorship of Caltrans (reference Chapter 2). Annual truck trip estimates are then factored down to daily truck trips using weigh-in-motion (WIM) data from a limited number of sites in the region.

The "internal model" estimates truck trip generation and distribution using more traditional methods. Truck trip generation rates were estimated for each weight class and a series of land use/industry types. The trip generation rates were estimated using data collected in a series of shipper surveys and supplemented with rates from studies in Phoenix, Arizona and the San Francisco Bay Area. Trip distribution for the "internal model" is based on a gravity model. Trip length frequency distributions were estimated from a limited number of trip diaries.

In both the external and internal models, the original limitations associated with the vast array of input data has always been a concern of SCAG staff. It would be desirable to collect additional data to validate commodity flows, origin and destination patterns, payload factors, time of day factors, trip generation rates, and gravity model parameters.

PROJECT GOALS

↓# Develop a comprehensive truck count database
↓# Conduct and document counts that have data reliability
↓# Develop a program for an on-going truck monitoring program
↓# Supplement and expand the existing truck count data and fill in gaps
↓# Facilitate refinement of the SCAG Truck Model
↓# Provide data on truck volumes by classification and land use
↓# Verify and improve knowledge of truck travel patterns and truck trips serving intermodal facilities and regional gateways
↓# Furnish annual and weekday truck traffic for modeling purposes and provide a base of information that will be useful for regional freight movement studies

PROJECT ADVISORY COMMITTEE

A mailing list of over eighty (80) people was developed. The Project Advisory Committee held monthly to bi-monthly meetings to help establish survey questionnaires, survey methodology, and analysis methodology. The committee consisted of staff members from:

↓# American Automobile Association of Southern California (AAA)
↓# California Highway Patrol (CHP) – Coastal, Los Angeles, Inland, Border and Enforcement Services Division
↓# California Trucking Association (CTA)
↓# Caltrans – Districts 5, 6, 7, 8, 9, 11, 12, and Headquarters
↓# City of Los Angeles
↓# Coachella Valley Association of Governments (CVAG)
↓# Consolidated Freightways
↓# Federal Highway Administration (FHWA)
↓# Kaku Associates Inc.
↓# Meyer Mohaddes Inc.
↓# Metropolitan Transit Authority (MTA)
↓# Orange County Transportation Association (OCTA)
↓# Port of Long Beach
↓# Port of Los Angeles
↓# Riverside County Transportation Commission (RCTC)
↓# South Coast Air Quality Management District (AQMD)
↓# San Bernardino Associated Governments (SANBAG)
↓# Southern California Association of Governments (SCAG)
↓# United Postal Service (UPS)
↓# Ventura County Transportation Commission (VCTC)

2. EXISTING DATA

TRUCK CLASSIFICATION COUNTS

Caltrans Classification Counts

Caltrans conducts a program of regular vehicle classification counts on all state highways. As the principal ongoing source of information about truck activity at the facility level, the Caltrans truck counts provide a critical data element for many regional planning studies. However, as mentioned in Chapter 1, there are characteristics of the Caltrans counts that suggest the need for supplementary information about truck volumes on roadways in the SCAG region.

Caltrans counts are taken on a rotating basis (ideally every six years in rotation – but for many sites the six year interval is not achieved due to resource constraints) and in some cases, many years have elapsed since verified counts have been taken. In addition, Caltrans does not conduct actual counts at all sites for which it reports data. Many sites have estimated counts based on trends at nearby sites that are verified. For all sites, even those that are verified, the vehicle volumes reported for years between verified counts are estimated using growth factors from nearby sites. In many critical goods movement corridors in the region, there have been significant questions raised about the application of estimated Caltrans counts.

Caltrans counts are Annual Average Daily Traffic (AADT) counts. The procedures for estimating AADT for trucks from limited count information are not well established. Little is known about day of the week and seasonal variations in truck traffic that can be applied to limited counts. The factors that may be predictors of this variation (geographic location of the facility, functional classification of the facility, types of trucks operating on the facility, types of commodities carried) are generally not considered in estimating AADT of trucks because little is known about the relationship between these factors and AADT.

Since Caltrans counts are AADT counts, they do not provide any information about temporal traffic patterns that are so critical to understanding congestion problems. While some of the sub-regional studies conducted throughout the SCAG region have examined temporal patterns of truck traffic, these studies are limited and do not represent a statistically valid sample of sites on a regional basis.

The fact that Caltrans counts are only taken on state highways means that many important facilities in the region are not included in the count program. Many of the principal arterial connectors that link major truck activity centers with the State highway system go uncounted.

Other Data Sources

Other attempts have been made to collect truck counts in sub-regional goods movement studies throughout the region. Sub-regional studies have been conducted in Gateway Cities, Los Angeles, Orange County, South Bay Cities, Inland Empire, and the San Gabriel Valley. All of these studies involved some level of truck count activity. But the selection of sites, the approach to vehicle classification, the type of equipment used, and the times of day and days of the week counted have varied and make it difficult to construct a comprehensive picture of truck activity in the region.

Other Modeling Issues with the Existing Count Data

The SCAG truck model was validated using a series of screenline counts. The screenline data were developed from Caltrans' truck counts. As described previously, the issues associated with these counts and the missing data on many key arterials suggest that a more comprehensive source of count data might improve the validation of the truck model.

Another modeling issue that could be addressed with additional count data is associated with the validation criteria that should be used in a truck model. There are no clear validation criteria for trucks so it was never clear whether the difference between estimated and observed truck AADT was reasonable given natural variations in daily truck traffic.

Another problem is that truck traffic in the model was estimated by weight class but validation counts were based on number of axles. The correspondence between axle counts and weight class bears further investigation in order to better understand the implications for interpreting results of weight class analysis with the model. A final issue with the assignment process was the procedure used to allocate AADT to the model's four time periods. This allocation was accomplished with a series of time of day factors taken from a limited number of 24-hour classification counts. Again, the accuracy of these factors on a regional basis was never established.

Reference Appendix A, Truck Classification Technical Memorandum and Appendix B, FHWA Classifications for further discussions on solutions.

SURVEY DATA

Caltrans Statewide Truck Survey

Another major program of truck data collection that could provide useful information to SCAG is the ongoing Statewide Truck Travel Survey being conducted for Caltrans by SCR, Inc. (Cambridge Systematics helped design the survey and developed a statewide truck modeling approach that established the data requirements for the survey). The statewide survey is a roadside intercept survey being conducted in seasonal waves at weigh-stations and agricultural inspection stations throughout the state. The utility of these data for SCAG's needs has yet to be examined.

Other Data Sources

The California Air Resources Board (ARB) and the South Coast Air Quality Management District (SCAQMD) have also been interested in truck activity data for the region. ARB sponsored a statewide study of truck activity using on-board global positioning system (GPS) data loggers to collect second-by-second data on the location of vehicles and their speed. The statewide sample included very few trucks operating in Southern California and the statewide sample was relatively small and exhibited a lack of diversity of truck types. In a second, ongoing study, ARB and SCAQMD sponsored a study of truck activity in the South Coast Air Basin that included 100-200 trucks equipped with GPS data loggers and a survey of over 1,000 trucks to obtain data on general operating patterns. These data had not been released in time for evaluation as part of the SCAG study. In the future, they may prove to be a useful supplement to count programs and truck origin-destination studies.

Modeling Issues with the Existing Intercept Survey Data

The SCAG model used data from a number of vehicle intercept surveys conducted by Caltrans during the early 1990s as inputs into the external model. These surveys were conducted at various external cordon locations in the region. Specifically, the intercept surveys were used to estimate payloads by commodity group, to estimate empty fractions and through trip volumes, and to determine the appropriate routings of traffic heading to or from specific external origins and destinations.

Unfortunately, the existing intercept surveys did not include sufficient data to estimate payload factors for all of the commodity groups with a high level of accuracy. These data had to be supplemented with statewide data from the U.S.

Truck Inventory and Use Survey (TIUS), now referred to as the Vehicle Inventory and Use Survey (VIUS).

The intercept surveys were also used to estimate the number of empty trucks and the number of through truck trips. The annual truck trip estimates and day-of-the-week distributions of truck traffic taken from weigh-in-motion (WIM) stations were then used to estimate truck average annual daily traffic (AADT) by truck weight class. These external truck trips were then assigned to specific external cordons using truck counts from each cordon. Had sufficient origin-destination data been available for all of the external cordons, this allocation process would have provided far more accurate results. In addition, the external origin-destination (O-D) surveys could have been used to validate the commodity flow information and would have greatly improved the calibration of the model. Unfortunately, only a handful of cordons were surveyed and several of these surveys were out of date.

3. DATA COLLECTION

CLASSIFICATION COUNTS

The SCAG Heavy-Duty Truck Model currently contains 13 screenline locations. Staff determined that 2 additional screenline cuts were necessary near the ports or South of Screenline #3 and in Riverside County between I-15 and I-215 south of SR 60. Based on existing screenline count data, SCAG and consultant staff determined 165 locations to conduct classification counts (reference Table 3-1 and Appendix C for graphical display of the screenlines). Classification counts were held at each location for a 24-hour period and truck counts were classified by number of axles, as follows:

↓# 2 axles
↓# 3 axles
↓# 4 axles
↓# 5 or more axles

Trucks with 3, 4, 5, or more axles were fairly easy to identify and count. Trucks with two axles needed to be identified separately from pickups, vans, and any other light-duty vehicles that should not be included in truck counts. The following outline provides examples to indicate the types of vehicles that were counted as trucks and the types of vehicles that were not counted as trucks. It should be noted that when a truck is towing a trailer, the number of axles counted includes both the number of axles on the truck and the number of axles on the trailer.

<u>Heavy-Duty Trucks Included</u>
- Platform trucks
- Public utility trucks
- Wrecker/tow trucks
- UPS trucks
- Federal Express trucks
- Any of the above with a trailer

<u>Excluded from Truck Count</u>
- Pickups
- Vans
- Mini-vans
- Sport utility vehicles (SUV’s)
- Station wagons
- Ambulances
- Buses
- Motorhomes
- Recreational vehicles
- Any of the above with a trailer

Table 3-1 Locations for Classification Counts

Loc #	Screeenline	Count Roadway	Location	Activity TYPE	County
1	1	I-5	S/O Zoo Dr, mp27.	1	LA
2	1	I-5	S/O Zoo Dr,	1	LA
3	1	SR-2	S/O 134, mpR18.81	1	LA
4	1	SR-2	S/O 134, mpR18.81	1	LA
5	1	US-101	S/O Barham Bl, mp	1	LA
6	1	US-101	S/O Barham Blvd	1	LA
7	1	I-405	S/O Mulholland Dr	1	LA
8	1	I-405	S/O Mulholland Dr	1	LA
9	1	SR 134 Off Ramp	W/B TO COLORADO	1	LA
10	1	SR 134 On Ramp	E/B TO COLORADO	1	LA
11	1	Central Avenue	Betw 134 & Doran	NC	LA
12	1	SR 27 Topanga Canyon	S/O Ventura Blvd	1	LA
13	1	San Fernando Road	S/O SR-134	3	LA
14	1	Cahuenga Blvd West	N/O Mulholland	3	LA
15	1	Sepulveda	S/O Mulholland Dr	3	LA
16	2	I-10	E/O 710, mp21.38	1	LA
17	2	I-10	E/O 710, mp21.38	1	LA
18	2	SR-60	E/O 710	1	LA
19	2	SR-60	E/O 710	1	LA
20	2	I-5	E/O 710, mp 13.78	1	LA
21	2	I-5	E/O 710	1	LA
22	2	I-105 (ANDERSON FWY)	E/O LONG BEACH FW	1	LA
23	2	I-105 (ANDERSON FWY)	E/O LONG BEACH FW	1	LA
24	2	SR-91	E/O 710	1	LA
25	2	SR-91	E/O 710	1	LA
26	2	I-405	E/O 710, mp7.60	1	LA
27	2	I-405	E/O 710, mp7.60	1	LA
28	2	7TH STREET	XING LA RIVER	3	LA
29	2	VALLEY BLVD	E/O Westmont	3	LA
30	2	WASHINGTON BLVD	Betw 710 & Atlant	3	LA
31	2	ATLANTIC AVENUE	N/O Bandini	3	LA
32	2	BANDINI BLVD	E/O Atlantic	3	LA
33	2	SLAUSON AVENUE	E/O 710	3	LA
34	2	FLORENCE	W/O EAstern Av	3	LA
35	2	SR 42/105-FIRESTONE	W/O Garfield	1	LA
36	2	SR-1	W/O Magnolia, mp7	1	LA
37	2	OCEAN BLVD	E/O Golden Avenue	3	LA
38	3	I-110	N/O El Segundo Bl	1	LA
39	3	I-110	N/O El Segundo Bl	1	LA
40	3	I-710	N/O Rosecrans	1	LA
41	3	I-710	N/O Rosecrans	1	LA
42	3	I-405, MP20.22	N/O Rosecrans	1	LA
43	3	I-405	N/O Rosecrans	1	LA
44	3	CENTRAL	N/O 120th St	3	LA
45	3	CRENSHAW Bl	N/O 120th St	3	LA
46	3	SR 1-SEPULVEDA, MP24.	N/O Rosecrans	1	LA
47	3	EL SEGUNDO BL	W/O I-405	3	LA

Table 3-1 (Cont.) Locations for Classification Counts

Loc #	Screeenline	Count Roadway	Location	Activity TYPE	County
48	4	SR 57 (Orange Fwy)	N/O ORANGEWOOD INT	1	OR
49	4	SR 57 (Orange Fwy)	N/O ORANGEWOOD INT	1	OR
50	4	SR 91	E/O of Tustin Av	1	OR
51	4	SR 91	E/O of Tustin Av	1	OR
52	4	I-5 Santa Ana FWY	S/O Chapman	1	OR
53	4	I-5 Santa Ana FWY	S/O Chapman	1	OR
54	4	SR 22 (Garden Grove Fwy)	E/O The City Driv	1	OR
55	4	SR 22 (Garden Grove Fwy)	E/O The City Driv	1	OR
56	4	I-405	Betw Euclid & Harbor	1	OR
57	4	I-405	Betw Euclid & Harbor	1	OR
58	4	LAKEVIEW AVE	Betw La Palma/Mck	3	OR
59	4	SR 90-IMPERIAL HWY	N/O 91	1	OR
60	4	GLASSELL ST	S/O 91	3	OR
61	4	LINCOLN AVE	West of Santa R.	3	OR
62	4	TAFT	W/O Main St	3	OR
63	4	KATELLA	W/O Main St	3	OR
64	4	CHAPMAN	W/O SR 57	3	OR
65	4	FAIRVIEW	S/O 17th St	3	OR
66	4	WARNER AVE	W/O Harbor Bl	3	OR
67	4	VICTORIA ST	E/O Brookhurst	3	OR
68	4	SR-1	E/O Brookhurst	1	OR
69	5	I-5	N/O Artesia Av	1	OR
70	5	I-5	N/O Artesia Av	1	OR
71	5	SR 57 (Orange Fwy)	N/O Tonner Cyn Rd	1	OR
72	5	SR 57 (Orange Fwy)	N/O Tonner Cyn Rd	1	OR
73	5	SR 91 (Artesia Fwy)	W/O Orangethorpe	1	OR
74	5	SR 91 (Artesia Fwy)	W/O Orangethorpe	1	OR
75	5	I-405	E/O Jct. Rt. 22 West	1	OR
76	5	I-405	E/O Jct. Rt. 22 West	1	OR
77	5	OLD RANCH ON RAMP	ON RAMP I 405	3	OR
78	5	ROSECRANS AVE	W/O Beach Bl	3	OR
79	5	LA MIRADA BLVD	W/O Beach Bl	3	OR
80	5	ARTESIA BL	W/O I-5	3	LA
81	5	SR 1	S/O Westminster	1	OR
82	5	SR 142 (Carbon Cyn)	E/O Valencia Ave	1	OR
83	5	Harbor Blvd	N/O Whittier Bl	3	OR
84	5	SR 72-WHITTIER BLVD	W/O Beach Bl	1	OR
85	5	TONNER CYN RD (MINOR	N/O Valecia	NC	OR
86	5	SR-90 (Imperial Hwy)	W/O Beach Bl	1	OR
87	5	VALLEY VIEW	S/O Artesia Bl	3	LA
88	5	Carson/LINCOLN	E/O Bloomfield	3	OR
89	5	CERRITOS AVE	W/O Los Alamitos	3	OR
90	5	WILLOW/KATELLA AVE	E/O I-605	3	LA
91	6	SR-91	Betw SR 71 & Serf	1	SB
92	6	SR-91	Betw SR 71 & Serf	1	SB
93	6	I-10	Betw Euclid & Cam	1	SB
94	6	I-10	Betw Euclid & Cam	1	SB
95	6	SR-60	Betw Euclid & Cam	1	SB
96	6	SR-60	Betw Euclid & Cam	1	SB
97	6	MISSION BLVD	Betw Euclid and Cam	3	SB
98	6	RIVERSIDE DR	Betw Euclid and Cam	3	SB

Table 3-1 (Cont.) Locations for Classification Counts

Loc #	Screeenline	Count Roadway	Location	Activity TYPE	County
99	7	I-215 (Riverside Fwy)	Betw I-10 & Wash'	1	SB
100	7	I-215 (Riverside Fwy)	Betw I-10 & Wash'	1	SB
101	7	I-15 (Devore Fwy)	S/O I-10	1	SB
102	7	I-15 (Devore Fwy)	S of I-10	1	SB
103	7	RIVERSIDE AVE	Betw Slover & I-10	3	SB
104	7	CEDAR AVE	Betw Slover & I-10	3	SB
105	7	SIERRA AVE	Betw Slover & I-10	NC	SB
106	7	MILLIKEN AVE	Betw Brickell & I	1	SB
107	7	RANCHO AVE	Betw 'N' & I-10	1	SB
108	7	ETIWANDA AVE	Betw Airport & I-10	1	SB
109	7	SR 83-EUCLID AVE	S/O Holt	1	SB
110	7	GROVE AVE	S/O Holt	1	SB
111	7	HAVEN AVE	Betw Airport Dr & I-10	1	SB
112	8	I-210	E/O 605	1	LA
113	8	I-210	E/O 605	1	LA
114	8	I-10	E/O 605	1	LA
115	8	I-10	E/O 605	1	LA
116	8	SR-60	W/O Azusa Ave	1	LA
117	8	SR-60	W/O Azuza Rd	1	LA
118	8	ARROW HWY	E/O 605	3	LA
119	8	LIVE OAK AVE	E/O 605	3	LA
120	8	TEMPLE AVE	N/O Railroad Ave	3	LA
121	8	HACIENDA BLVD	N/O Valley Bl	3	LA
122	8	VALLEY BLVD	E/O Stimson Av	NC	LA
123	8	FULLERTON RD	Harbor Bl	NC	LA
124	9	SR-60	E/O Moreno Bch Dr	1	RIV
125	9	SR-60	E/O Moreno Bch Dr	1	RIV
126	9	SR-30 (7/93)	W/O SR 330	1	SB
127	9	SR-30 (7/93)	W/O SR 330	1	SB
128	9	I-10	W/O Rte 30	1	SB
129	9	I-10	W/O Rte 30	1	SB
130	9	SR 74-PINACATE RD	W/O MENIFEE	1	RIV
131	9	SAN TIMOTEO CYN RD	N/O Palomares Rd	3	SB
132	10	SR 118	W/O LA/Ventura Co	1	VEN
133	10	SR 118	W/O LA/Ventura Co	1	VEN
134	10	US 101	E/O Westlake Bl	1	LA
135	10	US 101	E/O Westlake Bl	1	LA
136	10	SR 1	W/O LA Co Line	1	VEN
137	10	SR 126	W/O LA/Ventura Co	1	VEN
138	11	US101	E/O Camarillo Spr	1	VEN
139	11	US101	E/O Camarillo Spr	1	VEN
140	11	SR 126	W/O Sycamore Rd	1	VEN
141	11	SR 118-LOS ANGELES AV	E/O Bradley Rd	1	VEN
142	11	SR 1	At about Pt. Mugu	1	VEN
143	12	I-10 NORTH BND	E/O GENE AUTRY	1	RIV
144	12	I-10 SOUTH BND	E/O GENE AUTRY	1	RIV
145	12	SR 111	E/O GENE AUTRY	1	RIV

Table 3-1 (Cont.) Locations for Classification Counts

Loc #	Screenline	Count Roadway	Location	Activity TYPE	County	Mile Posts
146	13	I -15	N/O Sr - 138	1	SB	R21.37
147	13	I -15	N/O Sr - 138	1	SB	R21.37
148	13	SR - 138	E/O Sr - 2	1	SB	6.67
149	13	Sr - 18	@ Forest Boundary	1	SB	100.96
150	14	I-110	S/O Sepulveda Blvd	NC	LA	5.45
151	14	I-110	S/O Sepulveda Blvd	NC	LA	5.45
152	14	SR 103	S/O Willow St	NC	LA	
153	14	SR 103	S/O Willow St	NC	LA	
154	14	I-710	S/O Willow St	NC	LA	
155	14	I-710	S/O Willow St	NC	LA	
156	15	I-15	S/O SR 60	1	RIV	51.47
157	15	I-15	S/O SR 60	1	RIV	51.47
158	15	Van Buren Blvd	S/O SR 60	NC	RIV	
159	15	SR 91	S/O SR 60	NC	RIV	
160	15	SR 91	S/O SR 60	NC	RIV	
161	15	I-215	S/O SR 60	1	RIV	43.27
162	15	I-215	S/O SR 60	1	RIV	43.27
163	7	Foothill	Between Euclid/Campus	3	SB	
164	7	Cherry	Between I-10/Valley	3	SB	
165	7	Citrus	Between I-10/Valley	3	SB	

NOTE 1: CALTRANS right-of-way out of traffic, positioned to manually count truck traffic at subject locations.
NOTE 2: Type "3" locations are all on local arterials that do not involve CALTRANS right-of-way encroachment.
NOTE 3: Type "NC" were screenline locations originally identified for classification counts, but will not be counted at this time.

Appendix D contains the total classification counts for each screenline listed in Table 3-1 and for the ten (10) intercept survey sites described in Table 3-2. For specific locations, please contact SCAG.

EXTERNAL INTERCEPT SURVEYS

Survey Sites

SCAG staff identified 11 locations in the modeling area where data was not collected through the Caltrans statewide truck travel survey. For each of these external cordon station locations, a field review was conducted and specific site locations were identified in rest areas, at on- and off-ramps, and in one case along the mainline where a lane closure was required (reference Table 3-2 and Figure 3-1). At each of these locations appropriate traffic control plans were prepared (reference Appendix E) and necessary encroachment permits were obtained from Caltrans. It should be noted that a few weeks before the surveys were to be conducted another site review found that the I-40 location was undergoing construction through February 2002. As a result, this survey location was deleted from the survey list.

Table 3-2 External Cordon Station Intercept Locations

Location Number	Count Roadway	SCAG Location	Direction	Specific Site Review Location
1	US 101	Santa Barbara/Ventura County Line	Northbound	NB off ramp at Bates Road
2	US 101	Santa Barbara/Ventura County Line	Southbound	SB off ramp at Bates Road
3	SR 14	Los Angeles/Kern County Line	Northbound	Off ramp at Ave A (Cnty line between Kern and LA Cnty)
4	SR 14	Los Angeles/Kern County Line	Southbound	Off ramp at Ave A (Cnty line between Kern and LA Cnty)
5	SR 58	San Bernardino/Kern County Line	Eastbound	Boron Rest area - W of US395
6	SR 58	San Bernardino/Kern County Line	Westbound	Boron Rest area - W of US395
7	I-15	East of Calico Road	Eastbound	Clyde V. Kane Rest area - between Barstow and Baker
8	I-10	East of Dillon Road (near Indio)	Eastbound	Cactus City Rest area - E of SR 86
9	SR 86	Westmorland, Imperial County	Northbound	Between Martin Road & Lack Street
10	SR 86	Westmorland, Imperial County	Southbound	Between Martin Road & H Street

Figure 3-1 External Cordon Station Intercept Locations

Survey Forms

Based on the Caltrans Statewide Survey and other regional surveys, staff developed and the SCAG Advisory Committee approved a set of questions to be asked of during the survey process. Both mail back (reference Figure 3-2) and manual survey forms (reference Figure 3-3) were developed and contained identical survey questions in both English and Spanish. Manual survey forms were configured in a tabular format while the mail backs were placed on a post card with return address and pre-paid postage.

Pilot Survey

A pilot survey was conducted on October 26, 2001 at the Cactus City Rest Area, located on I-10 east of Dillon Road in Riverside County. The pilot site was chosen to identify and address traffic control issues and any needed refinements in the survey forms and questions. Required traffic control measures and safety precautions were also identified during the successful 4-hour pilot survey.

Training seminar

Approximately 100 temporary staff were hired and trained to conduct the truck intercept surveys. Special care and time was taken to coordinate with the temporary employment agency to screen and select appropriate staff. Given the high level of public visibility, safety and courtesy was a primary concern. Further, given the high level of Spanish speaking drivers bilingual staff were recruited for every shift of the survey. Survey staff training was essential in order to ensure safety and successful completion of the survey effort. Training was conducted at the University of California Riverside for approximately two hours on October 31, 2001.

Administration and scheduling of temporary staff was critical in keeping each of the roadside sites fully staffed and operational during the 24-hour period that surveys were being conducted. The availability of staff had to be

Figure 3-2 Mail Back Survey Form

2001 SCAG TRUCK EXTERNAL INTERCEPT SURVEY:
MAIL BACK QUESTIONNAIRE (QUESTION? Call 858/ 566-1766)

SURVEY STAFF ONLY: Date of trip:__________ Time:____________ A.M. / P.M.
Location #:__________ Route #:______________________________ Direction:__________

PLEASE ANSWER THE FOLLOWING QUESTIONS:

HAZMAT # ____________________ Registration State (*circle one*): *CALIFORNIA / OTHER*

Vehicle type (*circle one*):

2 Axle Single Unit | 3 Axle Single Unit | 4 or more Axle Single Unit | 3 or more Axle Single Trailer | Multi-Trailer | 2 or 3 Axle Tractor

# of axles (including axles of any trailers): ________ # of trailers: ________ Is this a container truck? (*circle one*) *YES / NO*

1. What is the Gross Vehicle Weight (GVW) Rating of the vehicle: ______________________
2. Are you currently carrying cargo? (*circle one*) *YES / CURRENTLY EMPTY / NEVER CARRY CARGO*
   2a. If yes, what is the primary commodity on board? ____
3. What is the weight of the cargo? ___________________ (*circle one*) *LBS. / KILOGRAMS*
4. Where is this vehicle (truck) based? City: ____________________ State/Province: ____________
5. Where did the truck last stop to load or unload?
   Route & nearest cross street: ________________________ City: _____________ State/Province: ________
6. Where will the truck stop next to load or unload?
   Route & nearest cross street: ________________________ City: _____________ State/Province: ________
7. In addition, how many other stops will you/did you make in Southern California today (excluding San Diego & Imperial Counties)? ____________
8. Is there a specific roadway problem in Southern California where you would like to see improvements?
   ____

Thank you for participating. Your survey will be submitted for a $500 cash prize lottery by filling out the following: Name: ______________________________ Phone: __________________

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO.27695 SAN DIEGO CA

POSTAGE WILL BE PAID BY ADDRESSEE

VRPA Technologies
9683 Tierra Grande, Ste 205
San Diego, CA 92126-9552

Figure 3-3 Manual Survey Form

Greeting: "Good evening/morning/afternoon. We are conducting a survey of truck travel for the Southern California Association of Governments. This information will be used to determine improvements to the highway system and help us predict future truck traffic in the region. The interview should take under 3 minutes of your time. Additionally, all completed surveys will be entered into a drawing for a $500 check."

Station #: 9 Route #: SR 86/78 NB Between Martin Road & Lack Street Date: 11/1/01

Vehicle type (for use with Question #IV):

#1 2 Axle Single Unit; #2 3 Axle Single Unit; #3 4 or more Axle Single Unit; #4 3 or more Axle Single Trailer; #5 Multi-Trailer; #6 2 or 3 Axle Tractor

SURVEYOR DETERMINANTS				QUESTIONS TO ASK DRIVER																	OPTIONAL FOR DRAWING:	
I	II	III	IV	V	VI	VII	1	2	2a	3	4		5			6			7	8		
Time	Vehicle type: *Use 1-6 from pictures*	# of axles (including axles on trailers)	# of trailers	Are you carrying HAZMAT material? If yes, what is the HAZMAT #?	Are you registered in CA or some other state?	Is this a container truck?	What is the Gross Vehicle Weight (GVW) Rating of the vehicle?	Are you currently carrying cargo?	If yes, what is the primary commodity on board?	What is the weightof the cargo? *If unsure: "Would it be over 66,000, 33,000-66,000, or under 33,000?"*	Where is this vehicle (truck) based? *If unsure: "Where is the truck garaged when not in use?"* City	State/ Province	Where did the truck last stop to load or unload? Address/ Route & Nearest Cross St	City	State/ Province	Where will the truck stop next to load or unload? Address/ Route & Nearest Cross St	City	State/ Province	In addition, how many other stops will you/did you make in Southern California (excluding San Diego and Imperial Counties)?	Is there any specific roadway problem in Southern California where you would like to see improvements?	Name:	Phone #
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												
AM☐ PM☐					CA ☐ OTHER ☐	YES ☐ NO ☐		YES ☐ CURRENTLY EMPTY ☐ NEVER CARRY CARGO ☐		LBS☐ KGS☐												

Salutation: "Thank you for participating in our survey. We are entering all completed surveys into a drawing for a $500 check. If you would like to enter please provide me with your name and phone number."

identified well in advance of the actual survey effort. Temporary staff worked in 8-hour shifts with two (2) breaks and an hour for meals. As a result, nine (9) temporary staff were used at each site. All staff were equipped with hard hats, vests, flashlights, clip boards and/or flags. As seen in the traffic control plans (reference Appendix B) two (2) staff members were placed in a survey bay to conduct on-site surveys and one (1) staff member was positioned as a flagger. VRPA staff served as floaters and substitutes for lunch breaks and for necessary supervision.

Conducting Intercept Surveys

Twenty-four (24) -hour intercept surveys were conducted during the month of November 2001 (reference Figure 3-4). During that same period, classification counts were conducted and used to analyze the data. Table 3-3 identifies the number of surveys that were taken at each intercept site. Additionally baseline statistics are shown in the table. Appendix D contains classification counts taken at each intercept survey location during the 24-hour survey period. For addition data collected during the intercept surveys, contact SCAG.

Data Validation

At the conclusion of the classification count and intercept survey collection, data was checked by VRPA Technologies for data validation purposes. At this point, VRPA Technologies turned the data over to Cambridge Systematics, Inc. for analysis, as described in Chapters 4-6.

Figure 3-4 Intercept Survey Schedule

SCAG Goods Movement Truck Count Study
Proposed Intercept Survey Schedule for Temporary Staff

October/ November

		Midnight		Midnight		
Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30 To be advised Survey training session 10am - 12pm **(all staff)**	31	1 #9 & 10 SR86 Westmoreland, Imperial County **(18 temp staff)**	2	3
4	5	6 #7 I-15 East of Calico Rd (btwn Barstow/Baker) **(9 temp staff)**	7	8 #1 & 2 US101 Santa Barbara/Ventura County Line **(18 temp staff)**	9	10
11 *VETERANS DAY*	12	13 #5 & 6 SR58 San Bernardino/Kern County Line **(18 temp staff)**	14	15 #3 & 4 SR14 Los Angeles/Kern County Line **(18 temp staff)**	16	17
18	19	20 #8 I-10 East of Dillon Road (near Indio) **(9 temp staff)**	21	22 *THANKSGIVING*	23	24

Table 3-3 Preliminary Intercept Survey Statistics

Survey Site	Route	Mailbacks	Surveys	Total Surveys	Actual Counts	% Surveyed
1	NB US 101	31	221	252	3,062	8.23%
2	SB US 101	42	344	386	3,032	12.73%
3	NB SR 14	28	207	235	1,119	21.00%
4	SB SR 14	55	203	258	1,179	21.88%
5	EB SR 58	70	463	533	3,636	14.66%
6	WB SR 58	31	299	330	2,262	14.59%
7	NB I-15	107	299	406	3,559	11.41%
8	SB I-10	136	341	477	4,309	11.07%
9	EB SR 86	3	216	219	1,151	19.03%
10	WB SR 86	13	212	225	1,167	19.28%
TOTAL ALL SITES		**516**	**2,805**	**3,321**	**24,476**	**13.57%**

Total mailbacks handed out		Spanish	500
		English	3,200
			3,700
	Response Rate %		**13.95%**
% of mailbacks vs. surveys		Mailbacks	**15.54%**
		Surveys	**84.46%**

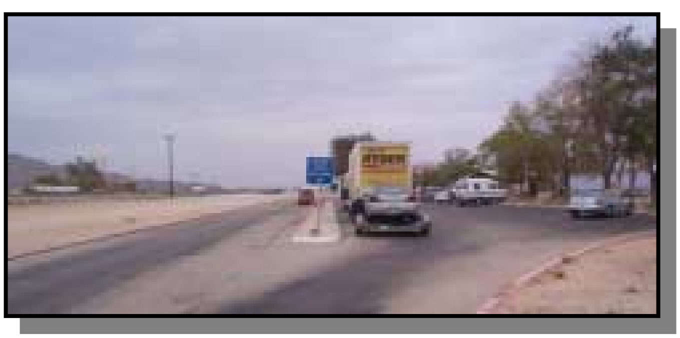
4. ISSUES ADDRESSED IN THE ANALYSIS

The original proposal for this project clearly indicates that the data collection program undertaken by the consultant team would not address all of the potential data needs of the Southern California Association of Governments (SCAG) Heavy Duty Truck Model. The data collection program was designed to provide (first and foremost) diagnostic data that can be used to focus resources in the future on those areas of model improvement that would provide the greatest benefit in terms of regional analysis. The results of this data collection program would identify issues, some of which could be addressed directly using the data collected in this program, and others that would need additional study. Therefore, it is useful to begin with a review of the modeling issues that can be addressed using the results from the analysis program.

ISSUES ADDRESSED IN ANALYSIS OF TRUCK COUNTS

Truck classification

A major issue in modeling truck activity for emissions analysis is the need to classify trucks by Gross Vehicle Weight (GVW) rating. Weight classification is required by the California Air Resources Board's (ARB's) emissions models but vehicle classification counts cannot directly capture GVW information. In the past, conversions from counts by number of axles to GVW were developed by ARB, but these are based on outdated information and data. In order to correct this, new conversion factors need to be developed.



Unfortunately, there is not a simple way to develop conversion factors directly from counts. The only way to accurately obtain GVW information for trucks is to intercept the trucks and read the GVW information from the nameplate or decode this information from the vehicle identification number (VIN). Since intercept survey locations within the region are very limited, another approach needed to be employed.

In this study, as in most past studies, the approach used to develop axle count-to-GVW conversions is based on cross-tabulating information regarding the number of axles with GVW ratings from truck population databases (i.e., the Department of Motor Vehicle registration files or the Vehicle Inventory and Use Survey). This was the approach used in this study and is further reported in a technical memorandum (reference Appendix A). The technical memorandum indicates that while a good correspondence can be developed between axle counts and GVW for heavy-heavy trucks, the conversion is less accurate for medium-heavy trucks and especially problematic for light-heavy trucks. The implications of this classification problem can be addressed by examining the relationship between model results by weight class and counts converted to weight class from axle groupings. . The analysis reported in Appendix A should be helpful to SCAG in determining how axle-to-weight class conversion factors are likely to impact the results of weight class analysis based on the truck model.

Use of the Caltrans truck counts as a source for model validation

The source of counts for validation of the SCAG truck model was the counts taken by Caltrans along the State highway system. This continues to be the most comprehensive source of truck classification counts in the region. But there are characteristics of the Caltrans counts that have potential implications if they are used to calibrate the model. Specific concerns about the Caltrans counts include:

↓# Regularity of the counts – Caltrans conducts vehicle classification counts on a six year rotating cycle, which means that at any given time, many of these counts are out of date. An examination of the Caltrans data reveals that due to limited resources, the goal of a six-year rotation is not met in all cases and some counts are more than six years old (some as old as 10 years). Older counts are extrapolated to the current year using growth factors developed from more recent counts at nearby locations. Given that truck activity is the fastest growing component of the traffic stream, the accuracy of the most critical counts in the Caltrans data set (e.g. the regional screenlines) should be verified prior to using them to calibrate the SCAG truck model.

↓# Estimated vs. verified counts – Not all counts reported in the Caltrans program are actual counts. Many of these counts are estimated based upon counts at nearby locations. As will be shown in the results of the analysis conducted for this project, most of the counts along screenlines used to validate the SCAG model are estimated counts.

- Factoring partial day counts to average daily traffic (ADT) – Caltrans does not conduct 24-hour counts. Partial day counts are expanded to daily counts using time of day factors. Given changes in the nature of truck activity in the region, the accuracy of this expansion methodology should be examined.
- Machine vs. manual counts – Caltrans uses four different count methodologies:
  - weigh-in-motion (WIM);
  - induction loops;
  - pneumatic tubes; and
  - manual counts.

  WIM and induction loops are used only when they are already installed at a count site, which makes their use very limited. Pneumatic tubes tend not to be used along freeways and are only used along arterials when traffic flow characteristics yield accurate results (this technique is less accurate for very congested operations). Since each of these methods has different levels of accuracy, the resulting counts will be of varying levels of quality.

The count program undertaken in this study used consistent count methodologies (manual counts), conducted over a 24-hour period, at every screenline location. Thus, comparison of the results with Caltrans counts should provide an assessment of how accurate Caltrans counts are as a validation source.

Predictions of arterial volumes

When the model was originally developed truck counts were not taken along arterials. Caltrans only conducts counts along State highways and classification counts along local roads are sporatic. By conducting counts along arterials with high predicted truck volumes, this study can be used to provide insight into how effective the model is at assigning trucks to the arterials as compared to freeways and other State highway facilities.

Time of day factors

The SCAG truck model uses 24-hour trip generation rates and then factors the rates by time period to develop trip tables for each of four time periods (AM peak, mid-day, PM peak, and night). In the original model development, a single set of time of day factors were used for all facility types and for all sub-regions. In this study, a much more robust set of 24-hour, hourly counts is available for examining the validity of the time of day factors.

Accuracy of the model for analysis of critical facilities and critical truck traffic streams

In the original model development process some effort was made to provide the greatest levels of accuracy along critical corridors and for the heaviest classes of trucks. The reason for this was the anticipated use of the model for critical corridor studies, most notably the truck lane studies and studies regarding access to major intermodal facilities. The analysis of the count data developed for this study can provide some insight into the degree of confidence that users of the model can have when conducting these studies.

ISSUES ADDRESSED IN THE ANALYSIS OF INTERCEPT SURVEY DATA

Effectiveness of the commodity flow technique for modeling external traffic flows

The SCAG truck model uses commodity flow data and associated techniques to model the traffic flows into, out of, and through the region. Analysis of the intercept survey data provides the first opportunity to evaluate how effective this approach is. These data can be used to compare total tonnage volumes at the external cordons, aggregate commodity distributions, origin-destination patterns, and conversion factors for tonnage to truck trips to determine if the commodity flow approach provides reasonable estimates of traffic volumes at the external cordons. Sources of discrepancy in each of these comparisons provide insight into how best apply these methodologies in the future.

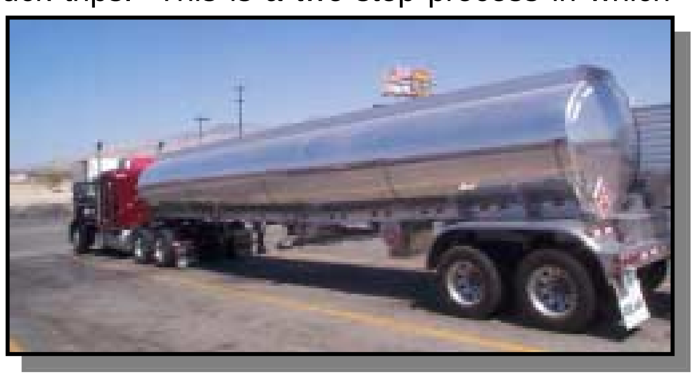
How accurate is Reebie commodity flow data as a primary source for modeling external flows

The commodity flow data used in constructing the SCAG external model are an enhanced version of the Reebie Transearch database. The enhanced data have similar characteristics to the Caltrans Intermodal Transportation Management System (ITMS) database. If the Reebie data in the SCAG model can be shown to provide reasonably good agreement with the commodity flows at the external cordons this would provide greater confidence in using these data in the future.

It should be noted, however, that the intercept survey data can only provide limited insight into the accuracy of the Reebie data. This is because the intercept surveys were only conducted for a single day and the commodity flows change from day to day and from season to season. Therefore, the commodity flow data presented in the analysis of the intercept surveys are presented at a fairly aggregate level of detail with respect to commodity groupings and origin-destination geography. Nonetheless, at this level of aggregation it is possible to determine how good a source the Reebie data represent for developing estimates of average daily truck traffic at the external cordons.

Validation of weight allocation across truck classes and truck payload factors by commodity group

A critical step in using the commodity flow data for modeling is the conversion of commodity tonnage values into truck trips. This is a two-step process in which the tonnage flows must first be allocated to the different truck weight classes (i.e., how much of the total volume of goods are carried by each truck weight class) and then converted to truck trips based on a payload factor. The payload factor is an estimate of the average load, in pounds, carried by a truck. Payload factors are calculated for each commodity group and for each weight class, thus the notion of a "payload matrix" (commodity group-by-weight class). The analysis conducted in this study provides an opportunity to validate the payload matrix in the model and to examine the implications of any changes in the payload matrix.



Validation of the routing assumptions at the external cordons

Routing assumptions at the external cordons take into account the external origins and destinations of the trips throughout the United States as well as the general internal origins and destinations. The U.S. is divided into several aggregate regions and logical interstate routes between the SCAG region and

these external regions are established in order to determine which external cordon will be used as the entry/egress point to/from the region. In several cases, multiple external cordon routes are possible and an allocation process was developed based on the relative truck volumes on these different routes and origin-destination data available from prior intercept surveys. These routing assumptions are used to establish the cordon origins-destinations in the external trip table. Actual routes within the region are then developed using the standard assignment algorithms in the model.

When the model was originally developed, there were only limited intercept surveys to work from in constructing the routing assumptions and several critical external cordons were not surveyed. The surveys conducted for this project, coupled with those conducted for the Caltrans Statewide Truck Travel Survey (conducted by Caltrans during 1999-2000) represent complete coverage of all of the major external cordon locations in the model. By analyzing the O-D patterns from the intercept surveys, it will be possible to validate the routing assumptions and make adjustments that would better reflect true routing patterns.

Through movements and empty volumes

The SCAG truck model estimates through movements and empty volumes at the external cordons using a series of factors that were derived from intercept surveys that were available at the time that the model was developed. As noted above, these intercept surveys were limited and did not cover all of the critical external cordon locations.

The method for estimating through movements was to examine origins and destinations at each of the cordon locations and determine the fraction of trips that pass through the region without making a stop. From these data, adjustment factors were developed for each cordon location in order to increase the volumes estimated directly from the commodity flow data. A similar approach was used to adjust the volumes to incorporate the effects of empty trucks since the commodity flow data only accounts for trucks that are carrying loads.

With more complete coverage of the external cordons and a larger sample of trips, the surveys conducted for this study (coupled with the Caltrans surveys) can be used to validate the through factors and the empty factors.

Time of day factors

As in the case of the internal model, time of day factors are used in the external model to allocate 24-hour truck volumes to the four (4) model periods. Again, the counts conducted for the external intercept survey can be used to verify these factors.

Chapters 5 and 6 of this report provides results from the study that can be used to address each of the issues highlighted in this Chapter.

5. ANALYSIS OF COUNT DATA

COMPARISON OF VRPA COUNT DATA AND WIM DATA

Caltrans collects extensive truck travel data through a number of weigh-in-motion (WIM) stations along the State highway system. The WIM station equipment provides data on number of vehicles, number of axles, vehicle weight, vehicle length and vehicle speed all stratified by 14 vehicle classification categories. Data on each vehicle are time stamped so that temporal variations in truck activity can be observed using WIM data. WIM data were used extensively in the development of the truck model, and are also used throughout the analysis of the VRPA count and survey data.

There are three WIM stations located close to VRPA count locations, as shown in Table 5-1. This section compares data from these locations to help compare the accuracy of truck counts from WIM data (the most reliable machine count methodology) and manual count data. Five consecutive weekdays of WIM data were averaged into a single weekday for the comparison with VRPA data. All of the data were taken from September and October of 2001 to avoid any seasonal bias between the two data sets. The WIM data and VRPA data classify trucks based on number of axles, which also allows for a direct comparison between the two data sets.

Table 5-1 Caltrans WIM Stations nearby VRPA Count Locations

	VRPA Location	**WIM Station**	**VRPA Location**	**WIM Station**	**VRPA Location**	**WIM Station**
County	L.A.	L.A.	L.A.	L.A.	Ventura	Ventura
Route	I-405	I-405	I-710	I-710	Hwy 101	Hwy 101
Milepost	37.0	42.9	15.0	11.5	10.7	12 (SB), 7.7 (NB)
Direction	Both	Both	Both	Both	Both	Both
Day of Data Collection	Tues., Wed.	Tues.	Thurs.	Thurs.	Tues., Wed.	Wed.
Date of Data Collection	Oct. 9-10, 2001	Sept. 26, 2001	Oct. 18, 2001	Oct. 11, 2001	Oct. 9-10, 2001	Sept. 26, 2001

There is a high correlation between the two count methods for trucks with 5 or more axles. The average differences in daily volume for this truck class between the VRPA and WIM data are 10% and 3% on the I-405 in the southbound and northbound directions, -18% and -4% on the I-710 in the southbound and northbound directions respectively, and 12% and 10% on Highway 101 in the southbound and northbound directions respectively. The average differences in hourly volume for this truck class were below 15% on each facility and in both directions. The daily and hourly average differences are shown in Table 5-2. Figures 5-1 (a)-(d) show the hourly distribution of truck trips for the WIM and VRPA data on the I-405 for trucks by truck class.

For combination vehicles, WIM data classifies 3-axle and 4-axle trucks into the same vehicle classification category. These axle groups were combined and compared to the same axle group in the VRPA data. Generally, the WIM equipment recorded higher volumes than the VRPA counts for 3-axle and 4-axle trucks. For example, on Highway 101, the VRPA data were 124% and 88% lower than the WIM data in the southbound and northbound directions respectively. The VRPA counts on the I-710 were 8% lower and 5% higher than the WIM data for the southbound and northbound directions respectively. This was the smallest differential of all three locations. Possible reasons for the higher WIM data include:

- WIM equipment recording pairs of closely spaced passenger cars as 4-axle trucks;
- Misclassification of tractors with no trailers as something other than 3-axle vehicles in the VRPA manual data collection; and/or
- Actual truck volume differences between the two different time periods of data collection.

For 2-axle trucks, the VRPA count data was between 15% and 61% higher than the WIM data depending on location and direction of traffic. This may be a result of WIM equipment having narrower criteria of what classifies as a 2-axle truck relative to the VRPA data. The WIM equipment rely on a combination of axle spacing, vehicle length and vehicle weight to separate 2-axle trucks from 2-axle passenger vehicles. The VRPA 2-axle classification process is based upon vehicle size and body type (visually observed). Two-axle freight-carrying vehicles that are empty may have been classified as trucks in the VRPA manual counts but not classified as trucks by the WIM equipment.

The differences between the 2-axle, 3-axle and 4-axle trucks balanced out so that the total trucks at each location are relatively close. The VRPA data range from 9% lower on the southbound portion of the I-710 to 29% higher on the northbound direction of Highway 101. The highest overestimation for total trucks was on Highway 101 due to its high percentage of 2-axle trucks.

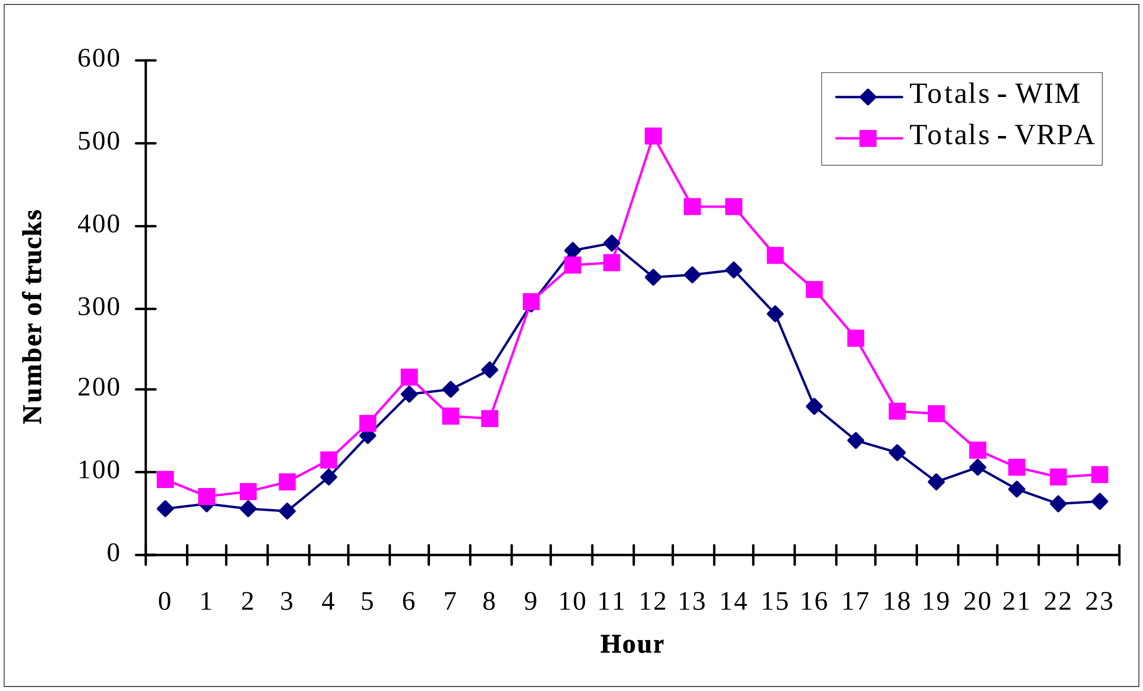
Table 5-2 Difference Between WIM and VRPA Count Data

Number of axles	Time Period	I-405 SB	I-405 NB	I-710 SB	I-710 NB	Hwy-101 SB	Hwy-101 NB
2-axle	Average Hourly Difference	42%	45%	9%	40%	48%	52%
2-axle	Average Daily Difference	39%	47%	15%	45%	56%	61%
3 or 4-axle	Average Hourly Difference	-22%	-65%	-11%	13%	-186%	-163%
3 or 4-axle	Average Daily Difference	-40%	-75%	-8%	5%	-124%	-88%
5+ axles	Average Hourly Difference	10%	4%	-7%	-2%	13%	11%
5+ axles	Average Daily Difference	10%	3%	-18%	-4%	12%	10%
Totals	Average Hourly Difference	23%	19%	-1%	11%	24%	22%
Totals	Average Daily Difference	20%	18%	-9%	9%	26%	29%

Conclusion on Accuracy of VRPA Count Data and WIM Equipment

The comparison between the VRPA data and the WIM data implies that the counts of trucks with 5 or more axles are very accurate using either manual or WIM data collection methods. The wide discrepancy between the counts for 2-axle trucks is consistent with problems commonly encountered classifying the lighter truck classes. The differences between the manual and WIM counts for the 3-axle and 4-axle classes are somewhat surprising. As detailed later, trucks in these classes are more likely to be heavy-heavy duty trucks. Detailed analysis of the classification accuracy of WIM equipment for 3-axle and 4-axle trucks could determine whether the WIM equipment overestimates in this vehicle class or if the manual count data underestimates for these trucks. Because truck models are usually concerned with heavy-heavy trucks, this determination is particularly important.

Figure 5-1 (a&b) Hourly Truck Volumes Using WIM Equipment and VRPA Counts, I-405, L.A. County, Northbound Traffic



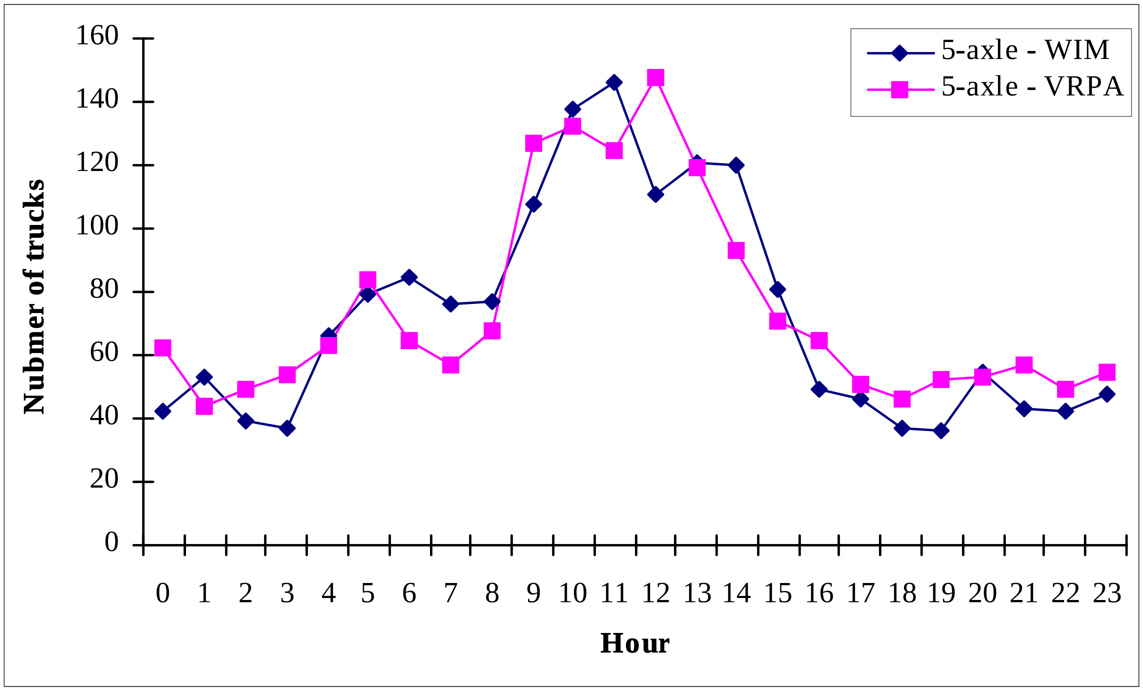
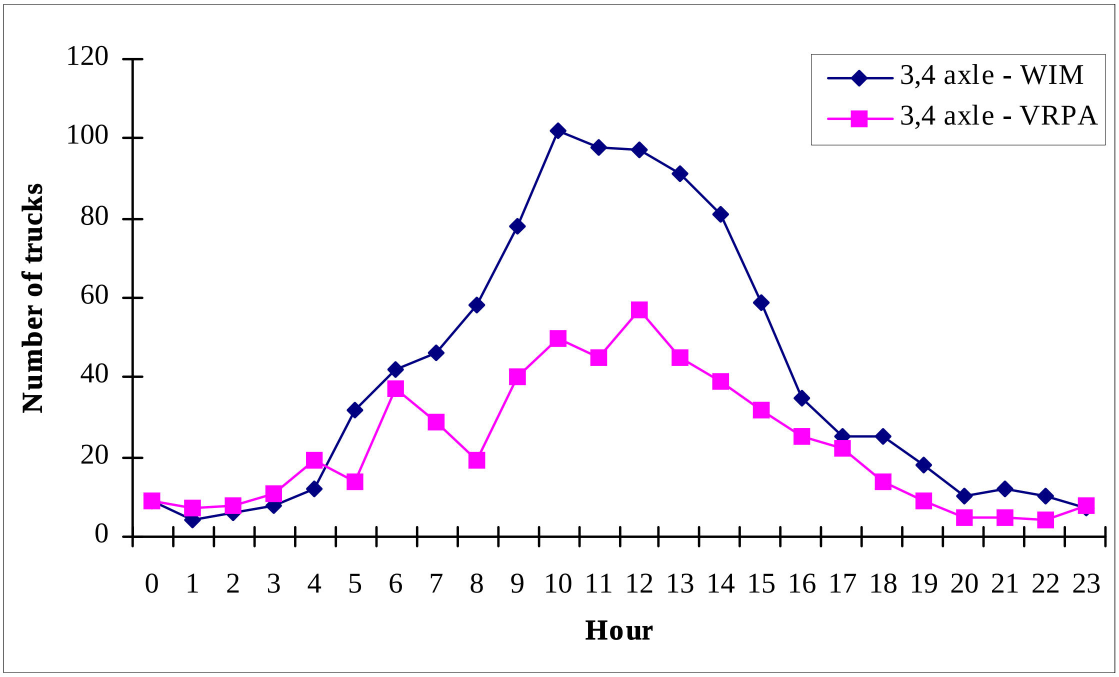
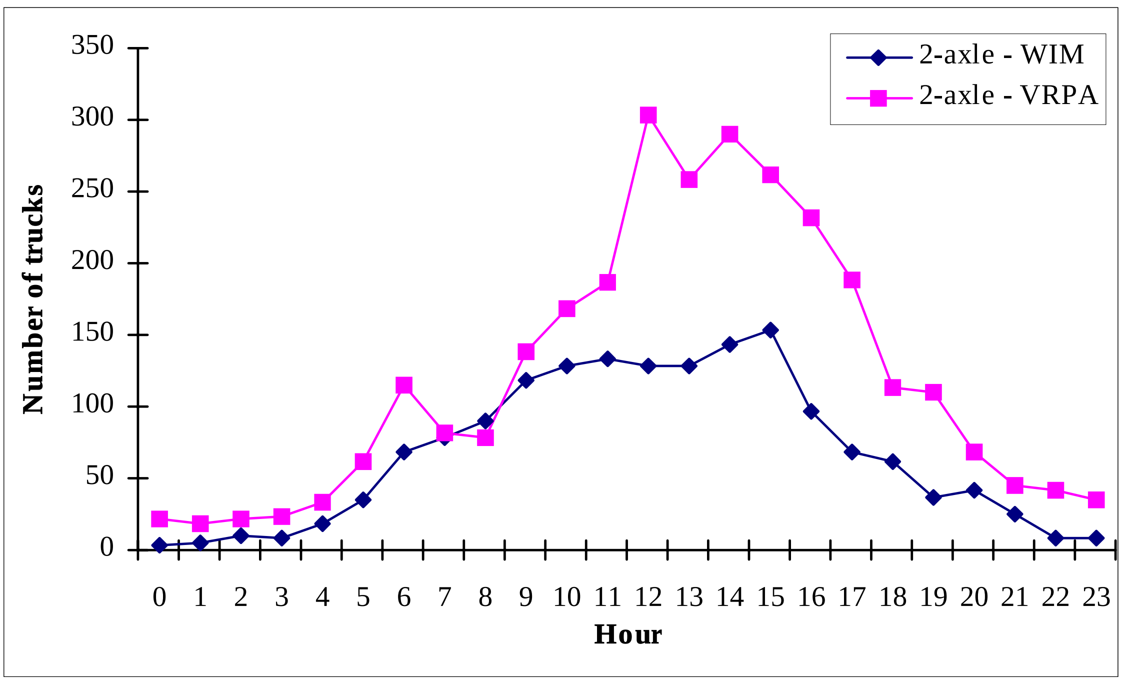


Figure 5-1 (c&d) Hourly Truck Volumes Using WIM Equipment and VRPA Counts, I-405, L.A. County, Northbound Traffic (continued)





COMPARISON OF VRPA COUNT DATA AND CALTRANS COUNT DATA

In addition to collecting WIM data, Caltrans also produces annual estimates of truck volumes at thousands of highway locations throughout the State. These data are shown in an annual report titled ‘Annual Average Daily Truck Traffic on the California Highway System’. This report is the most comprehensive source of truck count data for the State. Caltrans uses a combination of manual truck counts, truck counts from WIM data and extrapolation procedures to generate these estimates. Due to the large amount of resources required to collect count data, counts are performed strategically to maximize their effectiveness. Only select locations are actually counted, while others rely on factors applied to the most recent count at nearby locations. Several of the locations where actual counts are performed have not been counted since the early 1980s. This section compares the Caltrans truck count data to the VRPA data to explore the effects of using Caltrans data to calibrate the SCAG Heavy Duty Truck model.

Table 5-3 Caltrans Locations Used For Comparison with VRPA Data

Location Description	VRPA Screenline	County	Milepost/ Leg
Hwy 1	10	L.A.	59.901A
Hwy 1	2	L.A.	7.288B
Hwy 1	3	L.A.	21.919A
Hwy 1	4	Orange	21.549B
CA 2	1	L.A.	18.814A
I-5	1	L.A.	27.08B
I-5	2	L.A.	13.784A
I-5	4	Orange	34A
I-10	8	L.A.	31.151A
I-10	9	SBD	29.313B
I-10	2	L.A.	21.382A
I-10	6	SBD	3.468B
CA 22	4	Orange	10.478B
CA 27	1	L.A.	12.43B
CA 57	4	L.A.	10.83A
CA 57	5	Orange	19.858A
CA 60	2	L.A.	3.27A
CA 91	2	L.A.	11.681A
CA 91	4	Orange	9.187B
U.S. 101	10	Ventura	0.701A
I-105	2	L.A.	13.471A
I-110	3	L.A.	13.82B

I-210	8	L.A.	36.41A
I-215	15	Riverside	43.27B
I-405	4	Orange	16.544B
I-405	3	L.A.	23.355B
I-405	5	Orange	20.751A
I-710	3	L.A.	15.692B

There were 28 locations identified as having Caltrans truck counts nearby VRPA truck counts. These locations are shown in Table 5-3. Caltrans data classify trucks based on axle counts similar to the VRPA data. However, the Caltrans data are based on average annual volumes extrapolated to year 2000 as opposed to the 24-hour weekday counts performed by VRPA in the summer and fall of 2001. To compare the two data sets, VRPA data had to be adjusted to account for three temporal factors:

- Changes in economic activity between the time of the Caltrans estimates and the VRPA counts;

- Temporal bias in the VRPA data that resulted from data collected over one 24-hour period only during the summer and fall seasons; and

- The impact of the terrorist actions of September 11th on goods movement:

    - Changes in Economic Activity. Generally, truck volumes increase every year based on increases in economic activity. However, between the year of 2000 when the Caltrans estimates were developed and the time of the VRPA data collection in the summer and fall of 2001, an economic recession began. This called into question the normal assumption of growth factors for truck volumes. To determine the effect of the recession on truck volumes, WIM data were collected from three locations during the summer and fall of both 2000 and 2001. As shown in Table 5-4, the truck volumes in all three locations decreased between 2000 and 2001 indicating that the economic recession did indeed decrease truck volumes for the region. Therefore, the VRPA truck volumes collected in 2001 were actually increased by 4.0% to enable the comparison with the 2000 Caltrans truck volume estimates.

    - Temporal bias. Because the VRPA data were collected in the summer and fall of 2001, the data were also adjusted to account for seasonal variations in truck volumes. WIM data from January, April, July and October was collected at 11 locations to determine the effects of seasonal variation on the truck data. The percentage of trucks during each month was 23.8% in January, 25.4% in April, 26.0% in July, and 24.8% in October. These monthly percentages were applied to their respective seasons. The summer truck volumes are about 10% higher than the winter truck volumes. Applying the average distribution for all of the locations to the VRPA data is necessary to remove seasonal bias.

WIM data was also used to determine the factors needed to adjust VRPA data collected on a particular day of the week to ADT. Table 5-5 shows the factors developed from analyzing WIM data at 3 locations during each day of the week. Truck volumes between Tuesday and Friday are fairly consistent. However, Monday was found to be significantly lower than the other weekdays. This is likely due to low volumes during early Monday morning as an extension of the lower truck activity that occurs on the weekends. An adjustment factor of 1.086 was applied to VRPA data collected on Mondays to remove bias based on daily fluctuations in truck traffic.

- The Impacts of 9/11. The impact of the terrorist activities on September 11th was potentially problematic because some of the VRPA truck count data were collected before and after the event. In addition, the theoretical effect of 9/11 ranged from decreases in truck volumes that paralleled the short-term decrease in economic activity to increases in truck volumes reflecting risk-adjusted business inventories due to the new uncertainty in the overall economic environment.

  WIM data were used to determine the effect of September 11th on truck volumes. At three locations (I-10 in Riverside, Highway 101 in Ventura County, and I-5 in Orange County), one week of WIM data from July 2000 and October 2000 were compared to one week of WIM data from July 2001 and October 2001. The percentage decrease between the July and October truck volumes in 2001 was 6.4% compared to the 6.1% truck volume decrease in 2000. Based on a 95% confidence level, these percentages were not found to be significantly statistically different. Therefore, no adjustment factor was needed to account for changes in truck volumes from 9/11.

Table 5-4 Percent Change in WIM Truck Volume

Location	2000 Volume	2001 Volume	Percent change
I-10, Riverside County	82,129	80,289	-2.2%
U.S. 101, Ventura County	69,080	64,274	-7.0%
I-5, Orange County	110,957	108,514	-2.2%

Table 5-5 Truck Volume Percentages by Day of Week – All WIM Locations

Monday	Tuesday	Wednesday	Thursday	Friday
18.8%	20.6%	20.3%	20.5%	21.1%

Differences in Vehicle Classification Method

Both the Caltrans truck count data and the VRPA manual count data record and report truck classification counts by number of axles. For trucks with 3 or more axles, there should be an exact match in vehicle classification methods between the two data sets. However, for 2-axle trucks, there is still the potential for differences between the vehicles that are recorded as trucks. Based on the Caltrans Truck Count Book, the 2-axle truck category includes 1 ½ ton trucks with dual rear tires and excludes pickups and vans with only four tires. However, Caltrans manual data collection could not utilize the weight of vehicles to determine proper classification. Additionally, some of the Caltrans counts are based on WIM data, which cannot determine which vehicles have dual rear-tires. Therefore, internal consistency of the Caltrans data may not have been achieved. The VRPA count data excluded all pickup trucks from the 2-axle vehicles counts as described in Chapter 3. Therefore, there are differences between the 2-axle vehicles classified as trucks in the two data sets.

Comparisons of VRPA and Caltrans Data By Axle Group

Table 5-6 shows a statistical summary of the Caltrans data relative to the VRPA data. The truck volume estimates at the Caltrans locations were generally higher than the volumes from VRPA. On average, the Caltrans data were higher by 22.3%, 33.9%, 58.6% and 26.1% for trucks with 2, 3, 4 and 5 or more axles respectively. However, there is a large standard deviation in these average differences for each axle group. In addition, the median values of the differences for each truck class is lower than the mean. For trucks with 5 or more axles, the median is actually negative, reflecting the fact that the Caltrans volumes are actually lower than the VRPA totals at 18 of the 28 locations. The 95% confidence interval for trucks with 5 or more axles indicates that there is not a statistically significant difference between the Caltrans and VRPA data.

Table 5-6 Comparison of Average Differences Between Caltrans and VRPA Locations

Statistic	2-axle Trucks	3-axle Trucks	4-axle Trucks	5+ axle Trucks	All Classes
Mean	22.3%	33.9%	58.6%	26.1%	4.7%
Median	16.8%	17.0%	31.9%	-14.4%	-0.1%
Standard Deviation	56.0%	65.9%	139.2%	193.8%	34.9%
Confidence Interval (95%)	21.7%	25.5%	54.0%	75.1%	13.5%

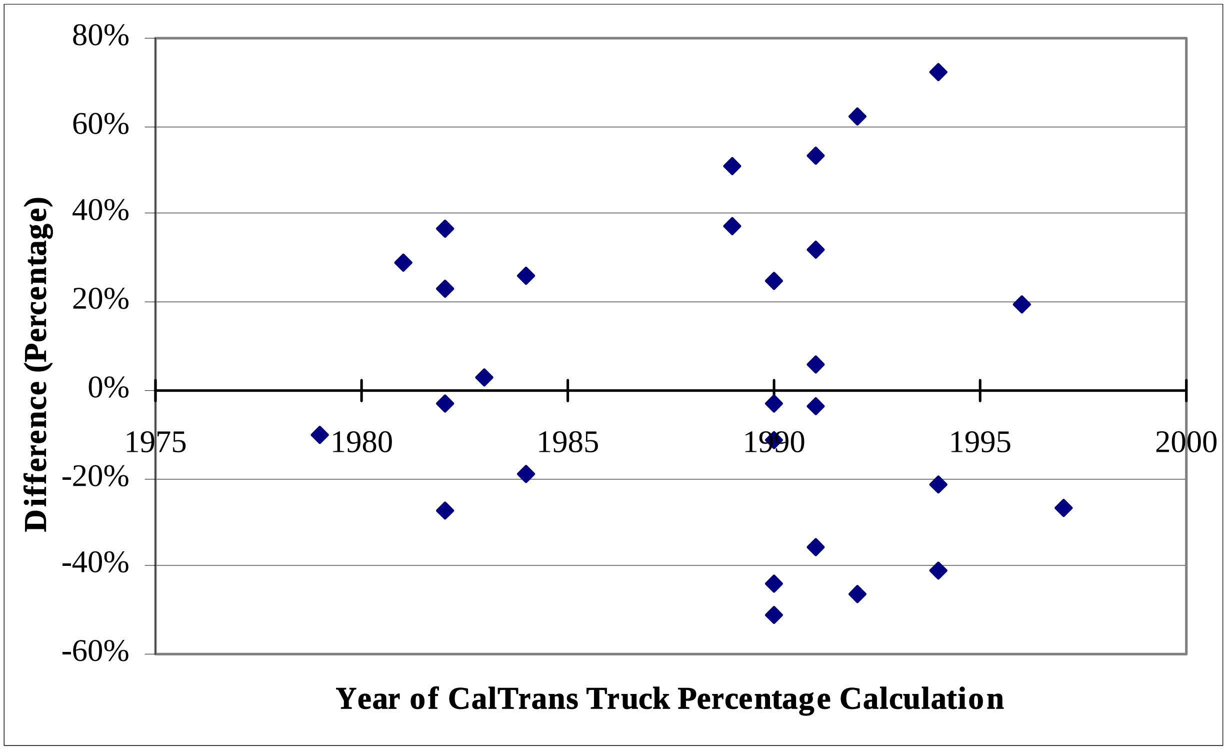
The higher volumes of 3-axle and 4-axle trucks in Caltrans counts relative to VRPA data are in line with WIM counts relative to VRPA counts for the same truck class. Only 9 of the 28 locations had lower 3-axle truck volumes for the Caltrans data compared to the VRPA data. Eleven of the 28 locations had lower counts for Caltrans 4-axle trucks compared to the VRPA data. However, there is some bias in these results due to the overlap between the 28 locations where Caltrans and VRPA locations are close together and where WIM stations and Caltrans locations are close together. Caltrans count data taken at these 28 locations are likely factored using a significant portion of WIM data. The 95% confidence interval for 3-axle and 4-axle truck classes show that the Caltrans data is slightly statistically higher than the VRPA data.

The higher volumes of 2-axle trucks in the Caltrans counts relative to VRPA data contrast with the results from the WIM data, which were much lower than counts from nearby VRPA locations. This is likely due to differences between which 2-axle vehicles are classified as trucks in each of the three truck classification methodologies. Thirteen of the 28 locations had lower 2-axle truck volumes for the Caltrans data compared to the VRPA data. The 95% confidence interval for the 2-axle truck class also shows that the Caltrans data is slightly statistically different from the VRPA data.

Accuracy of Caltrans Locations Relative to Year of Last Count

An analysis was performed to determine if a reason for the difference between the Caltrans and VRPA data was relative to the year of the last Caltrans count at the location. Some of the Caltrans manual count data is over 20 years old. A scatter plot was developed to look at the difference between the counts at each location relative to the year of the last Caltrans manual truck count at that location (or one nearby). The R-square for this regression is only 6% indicating that there is not a correlation between the two variables. The scatter plot of the regression data is shown in Figure 5-2.

Figure 5-2 Differential Between Caltrans and VRPA data Based on Year of Last Count of Caltrans Data



Actual vs. Estimated Caltrans truck volumes

Several of the most recent truck counts at Caltrans locations are actually estimated truck counts based on nearby manual counts. A statistical analysis was done of the difference between the truck volumes between the Caltrans and VRPA data at the sites with actual counts as opposed to the sites with estimated truck counts. The average error for the actual counts is 11.7%, while the average error for the estimated counts is –1.3%. While these data indicate that the data from the actual counts generates the higher values seen in the Caltrans data relative to the VRPA data, the means between these two data sets were not found to be statistically different based on a 95% confidence level.

Conclusions

The large percentage differences between the Caltrans data and the VRPA data for trucks with 5 or more axles is troubling because of the significance of this vehicle class as a source of mobile source NOx and PM pollution and their impact on road maintenance requirements and congestion. However, for this truck class, there was strong correlation between the VRPA and WIM data. This indicates that inaccuracies in the Caltrans data may be the cause for the large percentage difference between the Caltrans and VRPA data. Although, statistical analysis of the difference between the Caltrans data and the VRPA data for this weight class could not demonstrate a statistically significant difference at the 95% confidence level, the general trend of the data suggest that the Caltrans counts are high relative to the VRPA counts in many locations. Because the SCAG truck model was calibrated to the Caltrans data, it indicates that the model volumes will also be too high.

For 2-axle trucks, the Caltrans data are higher than the VRPA data which is higher than the WIM data. As mentioned previously, a large part of this difference is the result of different criteria for separating 2-axle trucks from the 2-axle vehicle pool. The criteria used by Caltrans is probably much more broad than that desired for the truck model. The Caltrans count data includes pickup trucks with 1½ tons (3,500 pounds) when they have dual rear tires. The lightest truck class in the heavy-duty truck model includes vehicles with a gross vehicle weight rating between 8,501 and 14,000 pounds. Therefore, the Caltrans counts likely include trucks with weight ratings lower than those included in the heavy-duty truck model. The more narrow definition of 2-axle trucks used for the VRPA or WIM data is much more likely to match vehicles relevant to the truck model.

COMPARISON OF USING VRPA DATA TO EVALUATE SCAG MODEL DATA

In the near future, SCAG will be updating the truck model using 2000 Census data. At this time it would be useful to conduct a re-validation of the model. The VRPA data can be used in this re-validation provided certain adjustments to the data are made. These adjustments are described below.

Preparation of the data

In order to make comparisons to a year 2000 base year, the VRPA data should be adjusted to account for the economic recession that began in early 2001, the seasonal bias of the VRPA data being collected in the fall and summer, and the day-of-week bias of the VRPA data being collected for one 24-hour time period.

An additional conversion is necessary to transform the axle classifications of VRPA data into vehicle classes based on the gross vehicle weight rating classes of the SCAG model. The truck model stratifies trucks into three gross vehicle weight (GVW) classes, as follows:

- Light-Heavy Duty Trucks (LHDTs): 8,501 to 14,000 pounds GVW
- Medium-Heavy Duty Trucks (MHDTs): 14,001 to 33,000 pounds GVW
- Heavy-Heavy Duty Trucks (HHDTs): 33,001 and over GVW

The conversion factors for vehicle classification developed for this study were based on the Vehicle Inventory and Use Survey (VIUS) data from 1997 for the State of California. The VIUS is a sample survey of private and commercial trucks registered (or licensed) in the United States. The survey is generally used to determine physical and operational characteristics of the Nation's truck population.

Table 5-7 shows the conversion factors developed from the VIUS data. Virtually all of the trucks with four or more axles are converted to the heavy-heavy duty truck GVW class. Of the 3-axle trucks, 87% convert to heavy-heavy duty trucks with the remainder converted to medium-heavy duty trucks. Approximately half of the 2-axle trucks convert to medium-heavy- duty trucks (MHDT), with the other half split between heavy-heavy (HHDT) and light-heavy duty trucks (LHDT). Therefore, difficulties in counting 2-axle trucks for model calibration will be reflected in inaccuracies in the truck model volumes for both light and medium duty trucks.

Table 5-7 Percentages of GVW Classes In Each Axle Class

Gross Vehicle Weight Class	**2-axle Trucks**	**3-axle Trucks**	**4-axle Trucks**	**5+ axle Trucks**
Light-Heavy Duty Trucks	23%	1%	0%	0%
Medium-Heavy Duty Trucks	56%	12%	3%	0%
Heavy-Heavy Duty Trucks	21%	87%	97%	100%
All Heavy Duty Trucks	100%	100%	100%	100%

Screenline data

The SCAG model was calibrated using 11 screenlines within the region. Comparisons were made of truck counts at each of the screenlines. Two additional screenlines were created in order to validate model output at locations on the outskirts of the SCAG modeling area. These screenlines are shown in Figure 5-3. This report uses the term ‘26 screenlines’ to refer to these screenlines along with their directional components. Each of these 26 screenlines is designated by its identification number within the 13 screenline set followed by the direction of traffic. For example screenline 1, which runs west to east in Los Angeles County, will include screenline 1NB and screenline 1SB.

Due to resource constraints, the VRPA truck count locations were chosen to include only the major roadways along each of the screenlines. These did not always include all of the minor roadways included in the truck model. The VRPA screenline data are presented in Figures 5-3 through 5-6. These results can be used in the future to conduct re-validation of the SCAG truck model.

Figure 5-3 VRPA Data by Screenline - HHDT

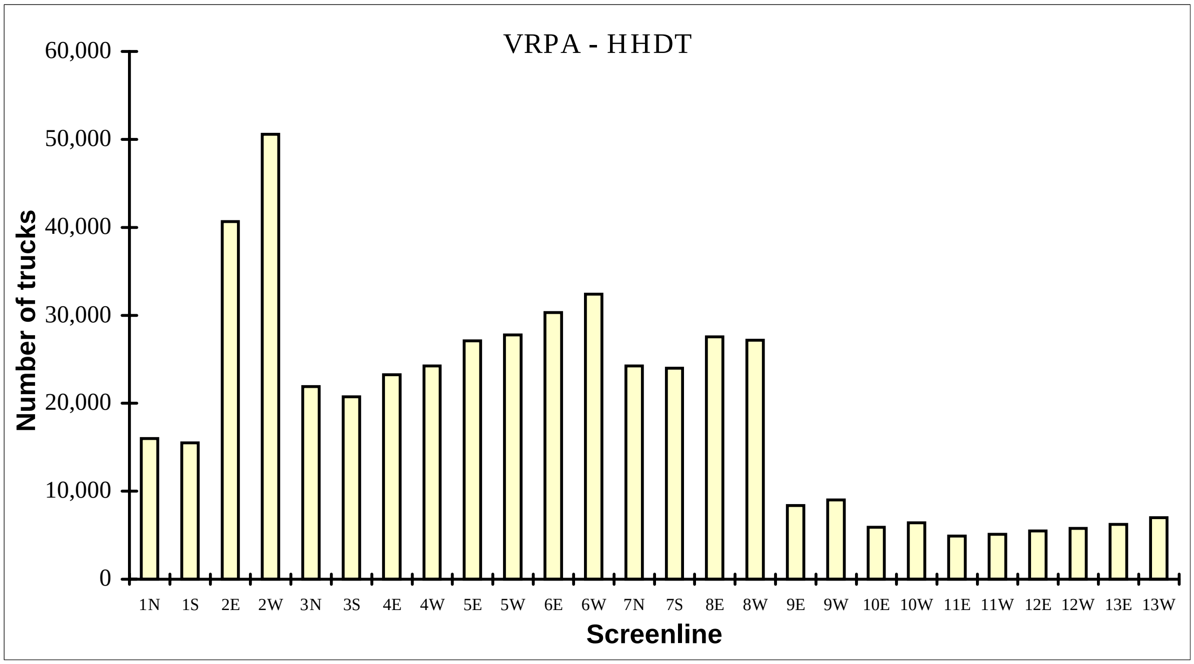


Figure 5-4 VRPA Data by Screenline - MHDT

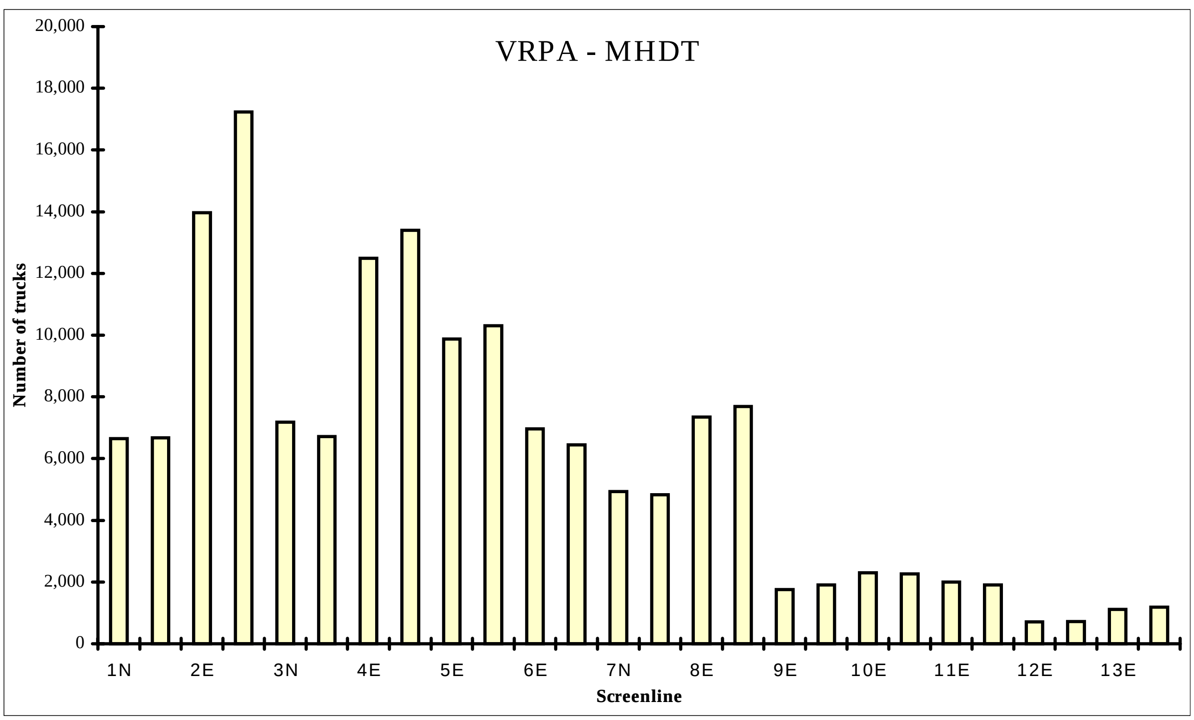


Figure 5-5 VRPA Data by Screenline - LHDT

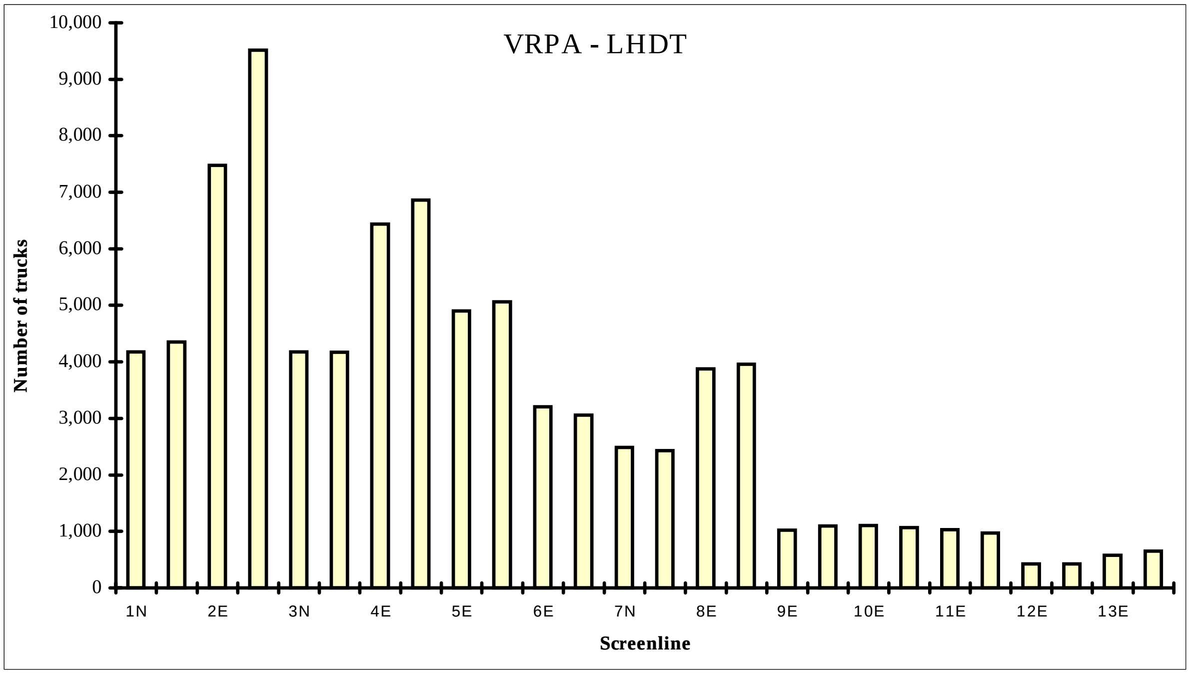
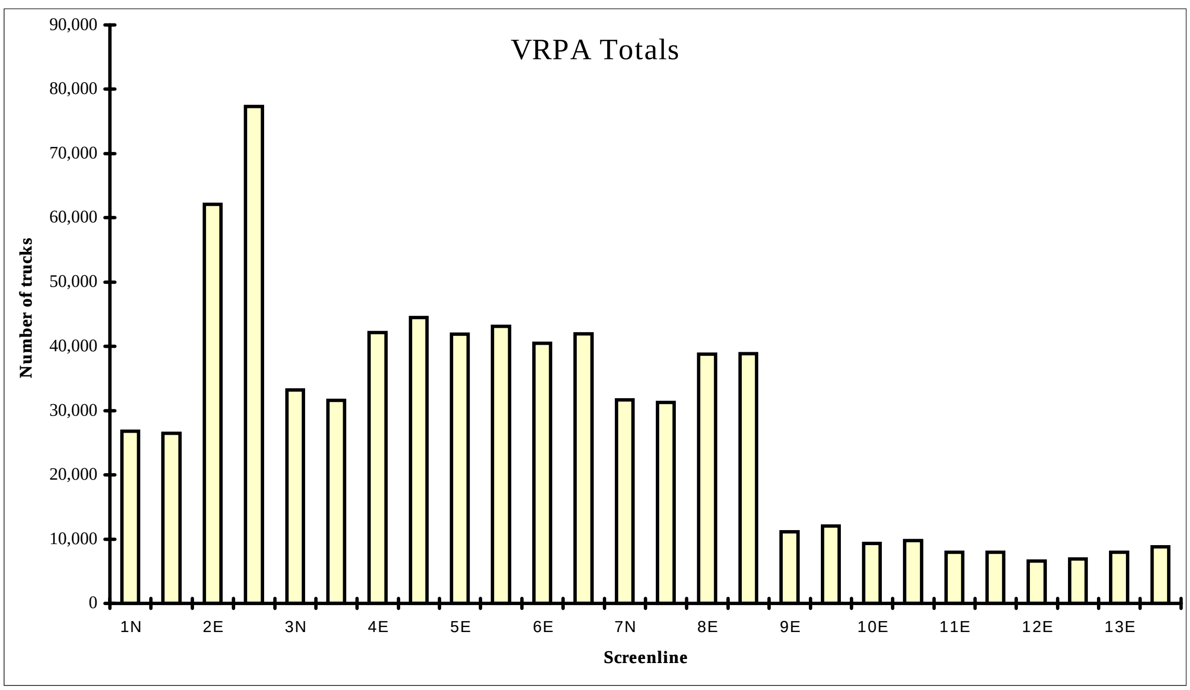


Figure 5-6 VRPA Data by Screenline - All Trucks



ANALYSIS OF TIME OF DAY FACTORS

In the truck model, trips are generated on a 24-hour basis. Before these trips are assigned they are converted to trips within each modeling time period. The four time periods are as follows:

↓# Morning peak, 6am to 9am
↓# Midday, 9am to 3pm
↓# Evening peak, 3pm to 7pm
↓# Night-time, 7pm to 6am

The model developed time of day factors to allocate the 24-hour trip tables to periods by using Caltrans WIM data at six (6) Southern California stations both within and outside the SCAG modeling area. Data from Wednesday, June 24th, 1998 were used for this analysis. WIM data from stations inside the study area were used to develop factors for internal trips, while data from stations external to the study area were used to develop time-of-day factors for external trips. The WIM axle count data were converted into GVW classes using the conversion correspondences in Table 5-8. The final time-of-day factors are shown in Table 5-9.

The model developed time of day factors to allocate the 24-hour trip tables to periods by using Caltrans WIM data at six (6) Southern California stations both within and outside the SCAG modeling area. Data from Wednesday, June 24th, 1998 were used for this analysis. WIM data from stations inside the modeling area were used to develop factors for internal trips, while data from stations external to the study area were used to develop time-of-day factors for external trips. The WIM axle count data were converted into GVW classes using the conversion correspondences in Table 5-8.

Using the hourly VRPA data, time-of-day factors can be developed from the truck counts along screenlines. These factors are shown in Table 5-9.

Table 5-8 Heavy Duty Vehicle Classification Correspondence Used in SCAG Truck Model

Caltrans/ FHWA Classification	SCAG Truck Model Weight Class
3	Light-Heavy
4	Medium-Heavy
5	Medium-Heavy
6	Medium-Heavy
7	Medium-Heavy
8	Heavy-Heavy
9	Heavy-Heavy
10	Heavy-Heavy
11	Heavy-Heavy
12	Heavy-Heavy

Table 5-9 Time Period Distribution Factors

Truck Class	Distribution Type	Morning Peak	Midday	Evening Peak	Night	Totals
LHDT	VRPA Counts	18.1%	46.3%	20.8%	14.8%	100%
MHDT	VRPA Counts	18.1%	46.1%	20.7%	15.1%	100%
HHDT	VRPA Counts	15.6%	41.1%	17.0%	26.3%	100%

The VRPA data were further stratified to determine if there was a difference in time-of-day factors based on several variables. The following time-of-day factor comparisons were performed:

- Eastern portion of the study area vs. central portion of the study area vs. western portion of the study area;
- East-west screenlines vs. north-south screenlines vs. diagonal screenlines; and
- Interstates vs. state highways vs. arterials.

Percentages during the morning and evening peak hours remained relatively flat across each of the comparisons. During the midday period, the north-south screenlines had 50% of the HHDT class volume compared to 40% for east-west screenlines. Also, the two western screenlines (#10, #11) had a higher percentage of trucks during the night-time period and a lower percentage of trucks during the midday period for all truck classes. However, for each of the other comparisons, there were not major differences seen for any of the truck classes during any of the time periods. It appears as though using a single time-of-day factor for internal truck trips is appropriate regardless of facility or location inside the study area.

6. ANALYSIS OF INTERCEPT SURVEY DATA

Primary data for the analyses presented in this Chapter come from the survey conducted for the project. The survey was conducted at 10 locations at or near the external cordon lines for the SCAG region study area. This survey was supplemented by the Caltrans Heavy-Duty Truck Travel Model Survey (CTMS) conducted throughout California in 1999. An additional nine locations (of fifty) for the Caltrans survey were at or near cordon lines for the SCAG study area. These 19 locations (Table 6-1) identify unique roadway directions for every major truck route entering and exiting the study area, except U.S. 395 and the eastbound segment of Interstate 40 in San Bernardino County.

Table 6-1 Roadway Segments from VRPA and Caltrans surveys

Route	Direction	Location	Survey
U.S. 101	North	Santa Barbara County Line	VRPA
U.S. 101	South	Santa Barbara County Line	VRPA
I-5	North	Castaic	Caltrans
I-5	South	Grapevine	Caltrans
CA 14	North	Kern County Line	VRPA
CA 14	South	Kern County Line	VRPA
CA 58	East	Kern County Line	VRPA
CA 58	West	Kern County Line	VRPA
I-15	East	Yermo	VRPA
I-15	West	Yermo	Caltrans
I-40	West	Needles	Caltrans
I-10	East	Coachella	VRPA
I-10	West	Blythe	Caltrans
SR 86	North	Imperial County Line	VRPA
SR 86	South	Imperial County Line	VRPA
I-15	North	San Diego County Line	Caltrans
I-15	South	San Diego County Line	Caltrans
I-5	North	San Diego County Line	Caltrans
I-5	South	San Diego County Line	Caltrans

The following sections describe the preparation and analysis of the SCAG intercept survey, as well as the use of the 1999 CTMS survey in the analysis.

DATA PREPARATION AND VALIDATION

The SCAG intercept survey data were collected at 10 stations throughout the SCAG region, with manual classification counts conducted at the same locations, as described in Chapter 3. Project staff performed a quality control process to check the validity and reliability of the data, generated useful additional variables for analysis, and conducted the analyses.

Several variables for which data were collected in the survey needed to be re-coded for analysis purposes. The survey collected data on actual GVW ratings of each truck. These data were coded into four weight classes as indicated in Table 6-2. These weight classes match those in the SCAG Heavy Duty Truck Model except that the heavy-heavy class is divided into two classes. This was done to be consistent with the manner in which payload (cargo weight) information is used in the conversion of commodity flows to truck trips in the SCAG model.

Table 6-2 Average truck weight by axle

Weight Class	**GVW Rating**
Light Heavy-Duty	8,500-14,000 lbs
Medium Heavy-Duty	14,001-33,000 lbs
Heavy Heavy-Duty	33,001-60,000 lbs
Super Heavy-Duty	60,001-80,000 lbs

Origin and destination (O-D) information was coded to counties for internal origins and destinations and to external regions that match the external regions used in the SCAG Heavy Duty Truck Model (see Figure 6-1). This allowed the consultants to make use of all the city and State information provided in the O-D questions in the survey.

Commodity data also needed to be coded. The survey interviewers recorded responses to the commodity questions exactly as they were reported by the drivers. The consultant team subsequently coded these responses in a two step process. First, the responses were coded to 2-digit Standard Transportation Commodity Classification (STCC) codes. These were then aggregated, for analysis purposes, to a smaller set of categories developed by the consultant team. The bridge from STCC codes to commodity groups is provided in Table 6-3.

Figure 6-1 External Region Map

Table 6-3 STCC to Commodity Group Bridge Table

STCC	Commodity Type	Group
1	Farm Products	Agriculture
8	Forest Products	Bulk
9	Fresh fish or other marine products	Agriculture
10	Metallic Ores	Bulk
11	Coal	Bulk
13	Crude Petroleum, natural gas or gasoline	Bulk
14	Nonmetallic minerals	Bulk
19	Ordinance or accessories	Bulk
20	Food and kindred products	Food Mfg
21	Tobacco products, excluding insecticides	Food Mfg
22	Textile mill products	Mfg -Durable
23	Apparel or other finished textile products	Mfg -Durable
24	Lumber or wood products, excluding furniture	Mfg -Nondurable
25	Furniture or fixtures	Mfg -Nondurable
26	Pulp, paper or allied products	Mfg -Durable
27	Printed matter	Mfg -Durable
28	Chemicals or allied products	Mfg -Durable
29	Petroleum or coal products	Mfg -Durable
30	Rubber or miscellaneous plastic products	Mfg -Durable
31	Leather or leather products	Mfg -Durable
32	Clay, concrete, glass or stone products	Mfg -Nondurable
33	Primary metal products	Mfg -Nondurable
34	Fabricated metal products	Mfg -Nondurable
35	Machinery excl. electrical	Mfg -Nondurable
36	Electrical machinery, equipment or supplies	Mfg -Nondurable
37	Transportation equipment	Mfg -Nondurable
38	Instruments, photographic goods, optical goods, watches, or clocks	Mfg -Nondurable
39	Miscellaneous products of manufacturing	Mfg -Nondurable
40	Waste or scrap materials	Bulk
41	Miscellaneous freight shipments	Mixed Freight
42	Empty Containers	Mixed Freight
43	US Mail	Mixed Freight
44	Miscellaneous freight shipments	Mixed Freight
49	Explosives	Mixed Freight
	Construction General (Not specified)	Bulk
	Household Goods (Not specified)	Mixed Freight
	Unknown	Unknown

In all cases where responses were coded to category variables, the project databases also include the raw response data.

Data validation and editing procedures

Several internal checks for data consistency were made to ensure the accuracy of data entry and survey responses. These checks include:

↓# Comparing gross vehicle weight rating with axle and truck type data;
↓# Comparing gross vehicle weight rating with cargo load data; and
↓# Comparing origins and destination with survey locations and directions.

The survey asked interviewers to classify each truck as one of five truck types (a visual identification), list the number of axles, and give the gross vehicle weight rating. The team established a list of possible values for “matching” sets of these items to identify observations that had apparently incorrectly specified answers to one or more of these questions. Table 6-4 identifies the range of values that are acceptable for the combinations of these variables. For example, observations of a Type 1 (a single unit 2-axle) truck should not have reported having any more than 2 axles.

Table 6-4 Quality control check of GVW rating, number of axles, and vehicle type

		Vehicle Type					
Axles	**GVW**	2-axle Single Unit	3-axle Single Unit	4+ axle Single Unit	3+ axle Single trailer	Multi-trailer	2 or 3 axle Tractor [1]
Two	< 14k						
	15-33k						
	33-80k						
Three	< 14k						
	15-33k						
	33-80k						
Four or more	< 14k						
	15-33k						
	33-80k						

Note: A clear box indicates an acceptable combination of variables.

[1] Though tractors without a trailer typically only have two or three axels, ARB classifies these as heavy heavy-duty trucks. For consistency, they were classified as such in the survey data.

A procedure to edit data for observations that fall into the gray squares of Table 6-4 was identified. In those cases where the record included responses for all three variables, it was assumed that if two pieces of information agreed, the third should be altered.

In cases with out-of-range values where no three pieces of information agreed, staff chose to exclude those pieces of data from the analyses, i.e., in subsequent analysis the value for each of the variables was considered "unknown." For example, if the respondent claimed that their truck was type 2 (3-axle single unit), listed the truck as having 4 axles, and claimed to have a gross vehicle weight rating under 14,000 pounds, there was no way to know which pieces of information were correct. These observations might still be useful for origin-destination or other analyses, but they were not included in analyses that required gross vehicle weight ratings.

Gross vehicle weight ratings and cargo weights

Survey respondents were asked to identify both the gross vehicle weight rating and the cargo weight (how much the cargo weighs, excluding the truck). In a significant minority of cases, respondents reported the total loaded truck weight instead of just the cargo weight. Using these values would significantly overestimate average payloads and total tonnage carried.

A methodology was derived that enabled staff to adjust the weights of cases that clearly over-reported the cargo weight. First, estimates of average empty truck weights (tare weights) by number of axles were created, based on information from truck manufacturers and WIM data (Table 6-5).

Table 6-5 Average truck tare weight by axle

Axles	Average Tare Weight
2	10,000 lbs
3	20,000 lbs
4	30,000 lbs
5	35,000 lbs

These are rough estimates, but provide values that help identify observations with out-of-range values. For example, a five axle truck with a gross vehicle weight rating of 80,000 pounds and a cargo weight of 80,000 pounds clearly includes the weight of the truck.

This information was used to develop a filtering process for identifying survey responses that clearly over-reported cargo weight data. If the type of truck is known (in this case type of truck is determined by the number of axles), when the reported cargo weight is subtracted from the reported gross vehicle weight rating, the result should be roughly the same as the tare weight for the corresponding vehicle type as reported in Table 6-5. If the difference between reported gross vehicle weight rating and reported cargo weight is much lower than the tare weights in Table 6-5, the cargo weight is probably over-reported and may actually be the total loaded weight of the truck. Because the tare weights in Table 6-5 or only rough estimates of average tare weights, a more conservative threshold value of the difference between GVW rating and cargo weight for each GVW class was developed, below which the reported cargo weight would be considered unacceptable. The average difference thresholds (between GVW rating and cargo weight) are given in Table 6-6. When this difference was smaller than the value listed in the table, the average tare weight (Table 6-5) was subtracted from the reported cargo weight value to obtain a more realistic estimate of the actual cargo weight (the assumption in these cases being that the reported cargo weight was actually the full loaded weight of the truck, including the tare weight).

Table 6-6 Maximum allowable truck weight by GVW rating

GVW rating	Threshold of difference between GVW and cargo weight
Over 65,000 lbs	30,000 lbs
40,000-60,000 lbs	20,000 lbs
20,000-40,000 lbs	10,000 lbs

Subtracting the average truck tare weight in all cases, may underestimate the weight of cargo carried by that truck. In some cases, drivers may have simply incorrectly identified their cargo weights, but may not be reporting an actual loaded weight. Though this is a problem, the assumption was made that drivers are more likely to accurately know their loaded weight (from weigh stations) and therefore report that, than to have incorrectly guessed their cargo weight.

This method still cannot account for all incorrect observations. It provides a filter through which the most egregious observations cannot easily pass without individually editing each observation based on a more subjective analysis of a particular case. There are two particular problems that it does not address:

↓# It does not provide a means to filter inaccurate cargo weight estimates for the light heavy-duty trucks, which are much more variable in weight than the others. An analysis of payloads for these trucks will be somewhat less accurate than for the other weight classes. Because these trucks comprise only a small portion of total trucks at external cordons, however, staff was not highly concerned about the small number of inaccurate cargo weight observations.

- It does not accurately filter the heavier-duty, but lightly loaded trucks. For example, if a truck has a GVW rating of 80,000 pounds but is carrying a 10,000 pound load, you would not suspect the accuracy of the record if the driver actually reported to the survey interviewer that the weight of his cargo was 45,000 pounds. This would appear to be well within the normal bounds of what a super heavy-duty truck can carry, but would tend to provide upward bias in our estimates of average payloads and total tonnage carried for this class of trucks. Staff concluded that the amount of this type of bias in the sample is relatively small since most drivers that reported cargo weights seemed to know these weights without much prompting and in some cases this information was included on their bill of lading, carried with them in the truck.

Origin and destination problems

Two types of problems with origins and destinations were identified easily when examining the data:

- Reported origin and destination are the same; and
- Origin and destination appear reversed based on the location of the truck survey (directionality always reported on the survey and could be checked against the assignment of the survey interviewer on the date and at the time the survey was undertaken).

Both of these problem cases have relatively straightforward solutions. In cases where the origin and destination are the same, the origin or destination was changed to unknown as appropriate. For example, if a truck was surveyed heading east on Interstate 15, and claimed to have an origin and a destination in Nevada, we assumed that the destination was correct and the origin was unknown.

Several observations contained reversed origins and destinations. For these cases, we assumed that respondents had simply reversed their answers to the two questions or they had been recorded in reverse by the surveyors. For example, if a truck was surveyed heading South on U.S. 101, but listed its origin in Los Angeles and its destination in Santa Barbara, the origin and destination values were switched.

EXPANDING THE SURVEY DATA

Project staff collected both survey data and count data at each of the locations surveyed. Counts were conducted manually at each location for a 24-hour period. Since only a sample of trucks were surveyed, the count data were used to expand (weight) the survey responses to represent the entire population of trucks that passed the survey location. This section describes the expansion (weighting) procedures.

First, it must be assumed that the counts of trucks represent the total trucks passing a given location on a given day. The day was originally divided into the four time periods used by the SCAG model (Table 6-7).

Table 6-7 SCAG model time periods

Period	Hours
Morning Peak	6 am – 9 am
Midday	9 am – 3 pm
Evening Peak	3 pm – 7 pm
Night-time	7 pm – 6 am

Analyses of variations in number of trucks, types of trucks, types of commodities carried, and other factors indicated that the night-time period should be split in two, divided roughly at midnight, i.e., the characteristics of truck traffic in the first half of the night (before midnight) were clearly different than those after midnight. The resulting five periods accounted for much of the variation in numbers and types of trucks passing at each location.

Truck counts at each location were collected only by time of day and number of axles. To expand the survey data both the counts and surveys were categorized by the five time periods, the number of axles (2, 3, and 4 or more), and the location of the survey and count. These were used to create a multiplication factor for each survey observation. Separate expansion factors were calculated by survey location, time period, and vehicle class. For example, if there were 4 surveys and 66 counts of two axle trucks in the mid-day time period at the Northbound U.S. 101 location, each of those 4 surveys received a multiplication factor of 16.5. That is, each of those four surveys represents just over 16 actual 2-axle trucks that passed during that time period at that location. A final list of expansion factors for each location, time period, and axle combination is given in Appendix F.

Several cases required minor adjustments to maintain the overall total number of trucks counted. In a handful of cases no surveys were collected for a particular combination of a location, time period, and axle group. These counts were added to adjacent time periods to ensure that these counts were included in data expansion.

In three cases, there were more surveys of a particular vehicle type than were reported in the counts. The counts for these cases were inflated slightly (by a total of seven trucks) and counts in adjacent periods were deflated by the same amount to maintain the overall total of counts. These cases could potentially include observations with mis-specified time periods or number of axles.

ADDING THE CALTRANS TRUCK TRAVEL MODEL SURVEY (CTMS)

The surveys conducted for this project were collected at a series of external cordon locations around the Southern California region. The locations were selected to be complimentary to a set of locations surveyed by Caltrans in 1999.

The purpose of the Caltrans CTMS survey was to collect representative truck travel data for subsequent use in the development of a forecasting model for statewide interregional heavy-duty truck travel in California. The survey data were used to help identify relationships between economic activity and truck travel patterns and to analyze commodity flows throughout California.

The CTMS collected data at nine locations in the Southern California region (Table 6-1). These locations, when combined with the SCAG survey identify almost every major road connecting the SCAG region with the rest of California and the United States.

The Caltrans data were used in concert with the SCAG Intercept Survey data collected for this study. The two surveys collected similar items and allow for an almost complete representation of the major truck movements and commodity flows into and out of the region. The rest of this section describes the differences between the Caltrans CTMS survey and the SCAG Intercept Survey; the difficulties encountered in constructing a GVW rating and in identifying actual cargo weights using the Caltrans CTMS survey; differences in the means used to expand the Caltrans CTMS survey; and the seasonal variation of the Caltrans CTMS survey.

Limitations of the Caltrans data

The Caltrans data have a number of limitations that reduce their compatibility with the SCAG Intercept Survey data:

↓# CTMS data were collected in 1999 and SCAG Intercept Survey data were collected in 2001. These two years represent very different economic situations for California.

↓# Caltrans only surveyed trucks with three or more axles, while the SCAG survey was for all trucks except pickups and vans. Light heavy-duty trucks (8,500-14,000 pounds) are completely excluded from the Caltrans survey and there were many fewer medium heavy-duty trucks (14,001-33,000 pounds) counted by Caltrans than in the SCAG survey.

↓# The CTMS did not include a question asking the gross vehicle weight rating. Because only three or more axle trucks were identified, almost every truck surveyed was a heavy-heavy-duty truck (33,000 pounds or higher gross vehicle weight rating). For comparison purposes for both the VRPA survey data and the SCAG model, it was necessary, but very challenging, to determine the gross vehicle weight rating of trucks counted in the CTMS. The method for this procedure is described below.

↓# The lack of gross vehicle weight ratings also made it quite difficult to determine how respondents to this survey answered questions about their cargo weight (see comments above).

The combination of these issues makes the Caltrans survey somewhat less reliable than the VRPA data as a source for conducting certain kinds of analysis, for example, especially when making comparisons to the SCAG Truck Model by weight class.

Constructing gross vehicle weight ratings for the CTMS data

The Caltrans CTMS survey did not include a question asking for gross vehicle weight ratings. Because this is a key piece of information for the SCAG model, it was necessary to construct a variable to approximate these ratings. The approximated gross vehicle weight ratings were derived from a combination of number of axles and cargo weights. A basic methodology for this process is described in Table 6-8.

Table 6-8 Constructing GVW Classifications for Caltrans Data

Axles	Cargo Weight	Estimated GVW
5 or more	Any	Over 66,000 lbs
3 or 4	Over 66,000 lbs	Over 66,000 lbs
4	Under 66,000 lbs	33,000– 66,000 lbs
3	33,000-66,000 lbs	33,000– 66,000 lbs
3	Less than 33,000 lbs	14,000– 33,000 lbs

As with the SCAG Intercept survey, numerous responses to the CTMS survey identified loaded truck weights instead of cargo weights, further complicating this process. The estimated ratings for the Caltrans CTMS survey will undoubtedly incorrectly identify some of the observations. Further, adjusting out-of-range values in the CTMS data could not benefit from known gross vehicle weight ratings. Instead, a simplified version of the process described above was used for observations with cargo weights over 60,0000 pounds. For these cases, weights were adjusted as a function of the number of axles (Table 6-9). A lack of information made it impossible to adjust the weight values more finely or adjust values below 66,000 pounds. As a result, the average payload factors and total tonnage carried are almost undoubtedly overestimated for the Caltrans CTMS survey locations.

Table 6-9 Caltrans cargo weight reductions for trucks over 60,000 pounds

Axles	Cargo weight reduced by
5 or more	35,000 lbs
4	30,000 lbs
3	10,000 lbs

Expansion Differences for the Caltrans CTMS Survey

The Caltrans CTMS Survey also included truck counts that prove useful for expanding the data into a representative day of truck traffic. Caltrans used video counts for 10 minutes out of each hour to generate the counts. For any given hour, these counts were multiplied by six to represent an entire hour.

Due to a lack of counts in all hours at some locations, only four expansion periods for the Caltrans data were used. The late night (7pm to Midnight) and the early morning (Midnight to 6 am) periods were combined into one.

The Caltrans CTMS survey had very few surveys of three axle trucks, making it difficult to create expansion factors. In the SCAG Intercept survey these holes were few enough to adjust counts between time periods without significantly impacting the results. For the Caltrans data, there were so few surveys of three axle trucks (at some locations there were none), that staff simply could not expand these data, even though there were counts of trucks passing. The result of this problem is that the final analyses of CTMS data underrepresented the total trucks by about 1,000 trucks.

Seasonal Variations in the Caltrans Data

One major advantage of the Caltrans data is that it included multiple collection times over the course of a year. Certain locations were surveyed as many as three or four times (once per season) over the course of the year. All locations were surveyed in the Spring of 1999. Of the nine locations at cordon points within the SCAG region, only two were surveyed at times other than the spring season. These two locations represent the Northern (towards Kern County) in and outbound traffic on Interstate 5. Both locations were also sampled in the summer and the winter.

TOTAL ANNUAL COMMODITY TONNAGE AND COMMODITY DISTRIBUTION

The base year commodity flow data for the external trip model were built from the Reebie Transearch database. This database was substantially upgraded to provide complete county-to-county detail within California and California-county to state detail for other domestic flows. This section provides estimates of annual tonnage generated from the VRPA and Caltrans survey data that can be used by SCAG staff to compare the survey results with the model commodity flow data inputs.

The survey data were aggregated into seven commodity groups corresponding to the 48 two-digit STCC classification categories used in the SCAG model, as follows:

↓# Agriculture
↓# Bulks
↓# Durable Manufacturing
↓# Nondurable Manufacturing
↓# Food Manufacturing
↓# Mixed Freight
↓# Other

Commodity groups are used because several of the individual two-digit commodities are a small percentage of the overall traffic and survey data of those commodities would likely not be representative of actual tonnage.

Commodity groups were selected that had similar physical characteristics, and therefore closely related consumption and shipping characteristics.

Table 6-10 Distribution of commodity movements for outbound and inbound trips

	Outbound Trips				
	Los Angeles	**Orange**	**Riverside**	**San Bernardino**	**Ventura**
Agriculture	8%	24%	23%	5%	29%
Bulk	5%	16%	9%	5%	10%
Food Mfg	27%	25%	29%	16%	13%
Manufacturing - Durable	19%	11%	6%	17%	22%
Manufacturing - Nondurable	21%	19%	20%	31%	13%
Mixed Freight	15%	3%	4%	22%	8%
Unknown/Empty	6%	1%	10%	5%	6%

	Inbound Trips				
	Los Angeles	**Orange**	**Riverside**	**San Bernardino**	**Ventura**
Agriculture	24%	24%	18%	37%	30%
Bulk	12%	0%	2%	4%	6%
Food Mfg	14%	42%	14%	16%	9%
Manufacturing - Durable	13%	8%	13%	8%	10%
Manufacturing - Nondurable	22%	19%	33%	17%	38%
Mixed Freight	10%	4%	16%	10%	3%
Unknown/Empty	5%	2%	5%	7%	4%

DISTRIBUTION OF TONNAGE BY WEIGHT CLASS AND PAYLOAD FACTORS

In this section, the truck class normally referred to as HHDT is divided into two subclasses. The first subclass is the HHDT class which includes trucks with a gross vehicle weight rating between 33,001 and 64,000 pounds. The second class is Super-Heavy Duty Trucks (SHDT), which includes trucks with a gross vehicle weight rating between 64,001 and 80,000 pounds. This provides additional detail compared to the classification with three classes, but was not available for other aspects of the SCAG model.

Distribution of Tonnage by Weight Class

In the SCAG truck model, the tonnage totals for each commodity are distributed to each of the four weight classes. Payload factors are then applied to each of the weight classes to determine the number of trucks generated for each weight class. Data from a previous survey were used to determine both the distribution percentages of tonnage across weight classes for each of the commodities and the payload factors for each weight class and commodity. This section provides estimates of conversion factors generated from the Caltrans and VRPA survey data. The VRPA survey is likely to be the more accurate of the two surveys due to the low percentage of the lighter trucks captured in the Caltrans survey. The results can be used by SCAG staff to assess the need for updates to the conversion factors used in the model.

Table 6-11 shows a comparison of the distribution of tonnage in the SCAG model and the distribution of tonnage in the VRPA and Caltrans surveys.

Table 6-11 Average Distribution of Tonnage to Truck Classes

Data Set	LHDT	MHDT	HHDT	SHDT	Totals
Combined VRPA and Caltrans Survey	0.1%	2.0%	5.0%	92.9%	100%
VRPA Survey Only	0.8%	6.7%	9.8%	82.8%	100%
Caltrans Survey Only	0.0%	0.3%	1.6%	98.1%	100%

Payload Factors

Payload factors calculated from data collected from the VRPA survey is shown in Table 6-12. Due to the difficulty in estimating GVWR from the Caltrans survey and the respondent error incorporated into the payload survey question, only the VRPA data were used for this estimate.

Table 6-12 Average Payload by Truck Classes

Data Set	LHDT	MHDT	HHDT	SHDT
VRPA Survey Only	6,501	11,879	14,158	28,493

ANALYSIS OF EXTERNAL ROUTING ASSUMPTIONS

In the SCAG truck model, trucks with external trip ends were assigned to cordon points based on their combination of origins and destinations. This routing was performed manually, with the route choice decisions based on a survey of 3,216 trips for the SCAG region, Caltrans truck counts, and conversations with Caltrans personnel and private trucking firms. The survey data were analyzed to determine actual routings for each O-D pair. The results were prepared for each county (the internal origin or destination) and tabulated by external region (external origin or destination) and the cordon used as the entry/exit route to the region. Table 6-13 shows the results for each county in the SCAG region and Table 6-14 presents the distribution of surveyed truck movements to and from major external regions. For each major external region identified in the SCAG truck model, the table identifies the percent of trucks to use a particular cordon line when entering or leaving the SCAG region. Figure 6-1 shows the external regions for the model. These results can be used by SCAG staff to determine how the routing assumptions in the model compare with actual routings determined from the survey.

Table 6-13 Allocation of Selected External Trips to Cordons for L.A. County

Cordon	Northwest states	Alpine, Inyo & Mono	Kern	Nevada
	Survey	Survey	Survey	Survey
U.S. 101	3%			
SR14	2%	100%	20%	11%
U.S. 395				
SR58	1%		1%	3%
I-15 (SBD Co.)	< 1%			84%
I-10	< 1%			< 1%
SR86				
I-5 (Kern Co.)	94%		79%	2%
I-15 (S.D. Co.)				
I-5 (S.D. Co.)	1%			
I-40				

Cordon	North Central States	Northeastern States	I-40 Belt	Southeastern States
	Survey	Survey	Survey	Survey
U.S. 101	< 1%			
SR14	3%	12%	1%	5%
U.S. 395				
SR58	3%	15%	3%	5%
I-15 (SBD Co.)	94%	41%		
I-10		32%	18%	89%
SR86				1%
I-5 (Kern Co.)				
I-15 (S.D. Co.)				
I-5 (S.D. Co.)				
I-40			78%	

Cordon	Arizona	San Diego, Baja	Santa Barbara	San Luis Obispo
	Survey	Survey	Survey	Survey
U.S. 101			93%	92%
SR14	1%		< 1%	
U.S. 395				
SR58	1%			
I-15 (SBD Co.)				
I-10	77%			
SR86	3%	< 1%		
I-5 (Kern Co.)			1%	8%
I-15 (S.D. Co.)		13%	5%	
I-5 (S.D. Co.)		87%		
I-40				

Table 6-14 Distribution of Cordon Lines to Regions

Cordon	Imperial	Santa Barbara	San Luis Obispo	Northwest States	Alpine, Inyo, & Mono
US 101 N/S		96%	94%	4%	
State Route 14 N/S		<1%	1%	2%	100%
State Route 58 E/W		1%	1%	4%	
I-15 E/W (Santa Bernardino)				<1%	
I-10 E/W	2%		2%	<1%	
State Route 86 N/S	98%			<1%	
I-5 N/S (Kern)		<1%	3%	88%	
I-15 N/S (San Diego)					
I-5 N/S (San Diego)		2%		<1%	
I-40 W					
Cordon	**Kern**	**Nevada**	**North Central States**	**Northeastern States**	**I-40 Belt**
US 101 N/S			1%	3%	
State Route 14 N/S	16%	6%	5%	7%	1%
State Route 58 E/W	7%	2%	4%	15%	3%
I-15 E/W (Santa Bernardino)		91%	89%	35%	6%
I-10 E/W		1%	1%	39%	20%
State Route 86 N/S	<1%	<1%			
I-5 N/S (Kern)	76%	1%			
I-15 N/S (San Diego)					
I-5 N/S (San Diego)					
I-40 W					70%
Cordon	**Southeastern States**	**Arizona**	**San Diego, Baja**	**Other California**	**Unknown**
US 101 N/S				4%	22%
State Route 14 N/S	3%	< 1%	<1%	25%	25%
State Route 58 E/W	4%	< 1%		24%	9%
I-15 E/W (Santa Bernardino)	5%	4%	<1%	12%	14%
I-10 E/W	86%	76%	<1%	2%	6%
State Route 86 N/S	2%	4%	1%	7%	10%
I-5 N/S (Kern)					12%
I-15 N/S (San Diego)			47%	27%	3%
I-5 N/S (San Diego)			52%		
I-40 W		16%			

The model does not include SR58 and SR86 as potential cordon points. The surveys indicate that these state routes carry a significant portion of traffic for certain O/D pairs. For example, the survey data indicated that SR58 carries 12% of the L.A. County to Northeastern States trips, 28% of the Orange County to Kern County trips, and 42% of the Ventura County to Nevada trips. For SR86, the survey showed that it carries virtually all flows to and from Imperial County, 23% of the flows between Ventura County and the Southeastern States, and 7% of the trips between Riverside County and Arizona.

There are differences in the sample sizes representing each of the external regions. Some smaller regions such as the Alpine, Inyo, and Mono regions had no trucks to those regions from any of the internal counties. Other county-to-external region pairs had a small number of samples indicating that the survey results would be less accurate. However, these pairs are also likely to have less trucks routed on them as well, so that the allocation would have less of an effect on overall flows.

ANALYSIS OF TIME OF DAY FACTORS

Table 6-15 shows time of day factors estimated from the surveys. These data can be used by SCAG to evaluate the time of day factors for external trips used in the model. The VRPA survey provides the best data source based on its large sample size and complete hourly counts (as opposed to the ten minute per hour counts taken for the Caltrans surveys). However, the Caltrans survey data appear to confirm most of the conclusions derived from the VRPA survey.

Table 6-15 Time Period Distribution Factors

Truck Class	Distribution Type	Morning Peak	Midday	Evening Peak	Night	Totals
LHDT	VRPA Survey	17.2%	46.2%	21.5%	15.1%	100%
MHDT	VRPA Survey	14.3%	39.1%	26.3%	20.3%	100%
MHDT	Caltrans Survey	8.0%	41.6%	29.4%	21.0%	100%
HHDT	VRPA Survey	11.6%	29.1%	19.5%	39.9%	100%
HHDT	Caltrans Survey	12.9%	34.6%	14.2%	38.3%	100%

ANALYSIS OF THROUGH TRIPS AND EMPTY FACTORS

Empty Factors

Empty factors in the truck model were developed based on the same survey that was used for other aspects of the external model. Axle groups from the survey were converted to weight classes using TIUS data. For some routes, such as US101 and I-10, O/D surveys were not available and estimates were derived from other routes. This generated three sets of empty truck percentages in the model that were used to describe traffic passing through various cordons. Volumes at cordon points were then increased according to these empty factors. Table 6-16 presents empty factors calculated for each of the VRPA and Caltrans survey locations. These data can be used by SCAG staff to assess the empty factors used in the model.

Table 6-16 Empty Truck Percentages

Survey	Cordon Description	Survey LHDT	Survey MHDT	Survey HHDT	Survey SHDT
VRPA	U.S. 101 North	n/a	6%	23%	18%
VRPA	U.S. 101 South	15%	30%	31%	37%
VRPA	SR14 North	7%	11%	40%	25%
VRPA	SR14 South	n/a	52%	31%	15%
VRPA	SR58 East	n/a	54%	11%	8%
VRPA	SR58 West	n/a	22%	10%	17%
VRPA	I-15 East SBD Co.	n/a	19%	15%	5%
VRPA	I-10 East	n/a	14%	2%	4%
VRPA	SR86 North	n/a	65%	27%	31%
VRPA	SR86 South	n/a	24%	19%	25%
VRPA Totals	All VRPA	14%	25%	14%	14%
Caltrans	I-10 West	n/a	n/a	n/a	26%
Caltrans	I-5 North Kern Co.	n/a	n/a	n/a	12%
Caltrans	I-5 South Kern Co.	n/a	n/a	n/a	4%
Caltrans	I-40 West	n/a	n/a	n/a	6%
Caltrans	I-15 North S.D. Co.	n/a	64%	15%	15%
Caltrans	I-15 South S.D. Co.	n/a	13%	32%	12%
Caltrans	I-5 North S.D. Co.	n/a	73%	29%	27%
Caltrans	I-5 South S.D. Co.	n/a	40%	43%	13%
Caltrans	I-15 West SBD Co.	n/a	n/a	n/a	49%
Caltrans Totals	All Caltrans	n/a	51%	30%	16%
Grand Total	All	14%	28%	19%	15%

Through Trips

In the SCAG model, an estimate was developed of the percentage of the daily truck volume that is making through trips at each of the major cordon points. These percentages were combined into an average two-way percentage and applied to the Caltrans count data to estimate the volume of through trips at each point.

The surveys used to develop the SCAG external model did not include origin-destination information for the U.S. 101, I-10 and CA 14 cordon points, so through trip information was constructed for these points based on surveys at the other locations.

Table 6-17 shows a trip table for through trips calculated from the combined VRPA and Caltrans survey data. This trip table can be used by SCAG staff to evaluate the through trip assumptions in the SCAG model.

Table 6-17 Through Trip Truck Volumes By Cordon

Origin Cordon	US 101	I-5 North	I-15 North	I-10
Destination Cordon	**Survey**	**Survey**	**Survey**	**Survey**
US 101 (SB Cty Line)	0	33	2	56
I-5 (Kern Cty Line)	237	0	0	662
I-15 Northbound	34	637	0	9
I-10 (AZ State line)	47	680	17	0
I-5 (SD Cty Line)	111	203	69	72
I-15 (SD Cty Line)	6	133	111	80
CA 14 (Kern Cty Line)	4	49	3	22
CA 58 (Kern Cty Line)	9	128	1350	1181
SR 86 (Imperial Cty Line)	13	123	9	6
I-40 Westbound	22	232	8	0
Model Cordons Totals Only	435	1686	199	879
All Cordon Totals	482	2218	1568	2087

Origin Cordon	I-5 South	I-15 South	CA 14	CA 58
Destination Cordon	**Survey**	**Survey**	**Survey**	**Survey**
US 101 (SB Cty Line)	34	12	23	25
I-5 (Kern Cty Line)	254	35	28	9
I-15 Northbound	10	423	37	148
I-10 (AZ State line)	3	141	36	103
I-5 (SD Cty Line)	0	1	66	15
I-15 (SD Cty Line)	0	0	10	22
CA 14 (Kern Cty Line)	18	3	0	1
CA 58 (Kern Cty Line)	1	59	25	0
SR 86 (Imperial Cty Line)	1	35	6	18
I-40 Westbound	7	303	14	55
Model Cordon Totals Only	302	613	201	321
All Cordon Totals	329	1013	245	396

Origin Cordon	Model	All Cordons
Destination Cordon	**Survey**	**Survey**
US 101 (SB Cty Line)	137	203
I-5 (Kern Cty Line)	1188	1408
I-15 Northbound	1112	1311
I-10 (AZ State line)	889	1032
I-5 (SD Cty Line)	456	543
I-15 (SD Cty Line)	330	371
CA 14 (Kern Cty Line)	0	105
CA 58 (Kern Cty Line)	0	3145
SR 86 (Imperial Cty Line)	0	212
I-40 Westbound	0	646
Model Cordon Totals	4113	4868
All Cordon Totals	4113	8975

7. RECOMMENDATIONS

This chapter of the report contains recommendations for how SCAG can move ahead to develop better data and a more accurate model for analyzing truck issues in the metropolitan region. The chapter highlights recommendations for ongoing truck monitoring and data collection programs.

RECOMMENDATIONS FOR ON-GOING TRUCK DATA COLLECTION/MONITORING PROGRAM

The results from this study indicate that the SCAG region could benefit from the development of a series of new on-going truck data collection and monitoring programs. In some cases, we recommend that these be established in coordination with Caltrans. In other cases we suggest that SCAG work with local cities and with consultants performing various traffic and planning studies to ensure that appropriate truck data collection programs are built into these ongoing programs and that guidelines are established for the types of data needed and the types of collection methods that should be used. Finally, we recommend that SCAG establish some one-time data collection programs to address specific needs for model improvements. Specific data collection program recommendations are provided below.

Establish a more regular truck count program for the region to support modeling and planning studies

For a variety of reasons already discussed in this report, the current vehicle classification count program does not meet the region's needs for model development and validation or for ongoing freight planning studies. The Caltrans data program has the following well documented shortcomings:

↓# Data are collected too infrequently;
↓# Many locations are never counted and counts are estimated;

- Most counts are not 24-hour counts and the expansion methodologies are suspect; and
- Many important arterials are not counted.

Nonetheless, it would be imprudent for SCAG to establish a completely independent classification count program. Every effort should be made to coordinate SCAG needs and the existing Caltrans program both to make best use of limited resources and to ensure greater consistency with data used statewide.

However this is accomplished, the SCAG region needs a count program that achieves the following objectives:

- All of the state highway facilities on the SCAG regional model screenlines should be counted manually on a 6-year rotation, with half counted every three years.
- The results of the analysis of time of day characteristics of truck activity by weight class conducted for this study suggested that the type of facility did not have a significant impact on the time of day distribution and that from screenline to screenline, the variation in time of day patterns was small. Based on these results and the need to conduct a cost-effective count program, we recommend that a sample of 36 locations be identified for 24-hour bi-directional counts and that the remainder of the counts be 10-hour counts (2-hours each in AM and PM peak and night, and 4-hour counts in the mid-day. The 24-hour counts should be conducted on 2 screenlines in each of the three geographic regions defined in this study (eastern, central, and western) and 2 locations each for each type of facility on each screenline (interstate, highway, arterial). The purpose of the 24-hour counts will be to ensure that time of day factors used to expand partial day counts to 24-hour ADT be kept current.
- In addition, partial day manual counts should be conducted in each of the four periods in the SCAG model on a multi-day basis once each season at each of the sample locations every ten years to help develop appropriate adjustment factors for the single day counts to take into account daily and seasonal variability not captured in a single 24-hour count.

Given the choice between tube counters and manual counts (the least cost options at present), manual counts appear to be the best choice given the range of traffic conditions and roadway configurations encountered on the screenlines and the desire to use consistent methodologies across all locations. However, in the longer term, SCAG and Caltrans should give consideration to the possibility of installing permanent count stations on the screenlines wherever possible. This should be part of a longer term investment strategy to improve traffic data in the region. Preference should be given to video count technologies. Wherever possible, the count locations in the program should be adjusted to take advantage of the availability of data that can be derived from ITS installations.

Work with the city and county transportation agencies to develop local count programs and establish guidelines for counts conducted as part of local traffic studies

This study confirmed that classification counts on arterials are very difficult to come by and that many arterials carry significant volumes of trucks. The best way to address the need for arterial counts is to work with the cities and counties that are responsible for these roads.

The sub-regional, city, and county agencies also often conduct themselves or through consultants, count programs as part of on-going traffic studies. These could prove to be a more useful regional resource if they are conducted in accordance with standard methodologies and meet minimum standards. SCAG should prepare a guidance document for classification counts in the region. The guidance document should specify definitions of vehicle classifications that would be consistent with the definitions used for modeling purposes and should provide guidance on how to conduct manual and machine counts to provide the most consistency with the vehicle classes defined in the SCAG program. In addition, the guidance document could provide acceptable expansion factors for partial day counts as well as providing guidance on time of day, day of week, and seasonal considerations in establishing counts.

A few counties (San Bernardino and Riverside) within the SCAG region have developed on-going classification count monitoring programs through the use of motorist aid call boxes and Caltrans Traffic Management Center (TMC) sites. These counties have added additional TMC sites and upgraded call boxes to smart call boxes with traffic counting capabilities and modems allowing them independent connection from the Caltrans permanent count stations and TMC system. This technology will allow these counties to download classification counts on an on-going or as-needed basis as they do for their Congestion Management Programs (CMP). SCAG should work with the San Bernardino Association of Governments (SANBAG) and Riverside County Transportation Commission (RCTC) to obtain truck classification counts from these new resources.

SCAG should also work with Caltrans and the county transportation agencies to ensure that all future corridor studies include classification counts designed to conform to the specifications developed in the guidance document. This should be incorporated in future RFPs.

Conduct more in-depth counts of arterials on selected screenlines

On a one-time basis, SCAG should conduct more in-depth studies of arterial truck activity to provide the basis for correcting assignment problems in the model. SCAG should select several screenlines that include both interstates and arterials and where interstate truck volumes are generally over-estimated and arterial volumes are generally under-estimated for these more in-depth studies. On these screenlines, 24-hour one day counts should be conducted at all of the interstate, highway, and arterial facilities cut by the screenline in order to check the assignment issues. Studies on 1 or 2 screenlines should be sufficient to get a better idea of how significant this problem is.

Conduct specialized speed studies

In the two studies of truck lanes that have been conducted in the region to date (the SR-60 truck lane feasibility study and the initial screening analysis of alternatives for the I-710 Major Corridor Study) it was observed that the effectiveness of tolling alternatives on truck lanes is very sensitive to the difference in speeds between the truck lanes and other facilities (mixed flow lanes and parallel arterials). These speed differences in the models do not seem to reflect average speeds for trucks in congested conditions. In addition, some studies have observed that heavy trucks, limited by law to the right 2 lanes on freeways, travel at lower average speeds than the rest of the traffic stream.

In order to ensure that the SCAG Truck Model reflects accurate congested speeds for trucks, we recommend that specialized speed studies be conducted in the region. To some extent, much of the necessary data should be available from existing weigh-in-motion sites. The data collection should focus on freeways and should examine speeds by lane and by vehicle class. If necessary, new volume-delay functions should be calculated for trucks on freeways in the SCAG Truck Model.

APPENDIX A
TRUCK CLASSIFICATION TECHNICAL MEMORANDUM

Memorandum

TO: Georgiena Vivian and Alan Havens

FROM: Michael Fischer

DATE: September 10, 2001

RE: Truck Classification

This memo provides the results of our evaluation of alternative definitions of "what is a truck" and alternative truck classification systems.

WHY IS TRUCK CLASSIFICATION IMPORTANT?

- We need a definition of what types of vehicles we are going to call a truck and what vehicles will not be called a truck in any study we are doing. Presumably, this definition will be based on the desire to distinguish vehicles that have a particular type of travel behavior and particular impacts on the system and the environment.
- Once we have defined what is a truck and what is not, we may want to recognize that different types of trucks have different travel behavior with respect to trip generation, trip distribution, and route choice. Travel behavior is generally a function of the usage of a truck and usage may be related to the body type, configuration, or size of the vehicle.
- Different types of trucks have different impacts on pavement wear and this is a key reason for collecting and forecasting data on truck activity. We generally want to know something about Equivalent Single Axle Loads (ESAL) which is related to truck weight and the number and spacing of axles.
- Different types of trucks have different emissions characteristics. Emissions are a function of the type and usage of the engine in the truck and this is related to the gross vehicle weight rating (GVWR) of the truck.
- Different types of trucks have different impacts on congestion. Congestion is typically measured in terms of volume/capacity ratios. To provide a consistent measure of vehicle volumes, truck volumes are often converted to passenger car equivalents (PCE). PCE values are generally a function of vehicle size in addition to other traffic and roadway condition indicators.

WHAT ARE THE RELEVANT TRUCK CLASSIFICATION SYSTEMS?

1. **Number of axles** - The total number of axles on the trucks are normally categorized into five axle categories – 2 axles with 4 tires, 2 axles with 6 tires, 3 axles, 4 axles, and 5 or more axles. Number of axles can be determined by visual identification in manual counts. However, due to the expensive nature of manual classification counts, axle sensor based counters are often used to collect truck counts. These counters measure the number of axles associated with each passing vehicle and the spacing between axles. Information about the number and spacing of axles can be fed into algorithms that further classify the vehicles (i.e., particular vehicle configurations may have unique number and spacing of axles).
2. **Gross Vehicle Weight (GVW)** - GVW is a unique characteristic of a vehicle that is the maximum rated weight at which the vehicle can be operated. It generally reflects the structural design (suspension) and engine power characteristics of the vehicle. GVW classification ratings are primarily used by the Air Resources Board (ARB) for air quality modeling purposes. Since the SCAG model was developed with funding from the South Coast Air Quality Management District and one of its primary envisioned uses is to improve mobile source emissions estimates for trucks in the region, the model was designed with truck classes defined to be consistent with the definition of heavy-duty trucks in the ARB's EMFAC 7G model – light-heavy (8,501-14,000 lbs.), medium-heavy (14,001-33,000 lbs.), and heavy-heavy (> 33,000 lbs.) GVW ratings of vehicles cannot be observed or measured by on-road classification counters but can be determined while administering intercept surveys.
3. **Vehicle Configuration** - This is primarily based on the physical appearance of a vehicle. The classification scheme adopted by FHWA separates vehicles into 13 categories depending on whether the vehicle carries passengers or commodities. Non-passenger vehicles are further subdivided by number of axles and number of units both power and trailer units (i.e., single unit, power unit plus one trailer, power unit plus tandem trailers, etc.). Vehicle configuration can be determined by machine counters that provide number and spacing of axles or even length based counters that provide length of vehicles.
4. **Length of Vehicle** - The length of a vehicle is also an important variable of interest if it can be measured accurately. The counters recommended by the FHWA Traffic Monitoring Guide use two inductance loops to estimate length of vehicles crossing the loops.
5. **Body Type** - This type of classification is based on the appearance of the body of the vehicle. Body type can only be observed visually and the

classification systems used in different data sources are not always consistent. Classification can be fairly subjective.

WHAT ARE THE DIFFERENT OPTIONS FOR COUNTING TRUCKS ON THE ROAD?

1. **Intercept interviews** – While not a practical means of conducting truck counts, we nevertheless mention intercept interviews because we will be conducting these for the purpose of collecting certain origin-destination information and this creates an opportunity to develop a database for certain cross-classification analysis. In an intercept survey it is possible to observe or obtain information about every one of the classification variables described above. The method is very costly, not appropriate for certain types of facilities (internal roadways in general and non-highways in particular), and can only be used to count a fraction of the trucks passing a given location.
2. **Tube counters** – Pneumatic tube counters collect data when a vehicle crosses the tube to create a measurable impulse. For classification counts, two tubes with a known spacing are placed on a roadway. When the front wheels of a vehicle contact the first tube a pulse is generated and the time until a pulse is generated at the second tube can be measured. This information can be used to calculate the vehicle speed. When subsequent pulses are generated, the time intervals and speed information (as well as information about axle spacing for standard vehicle configurations) can be used in an algorithm to estimate number of axles and axle spacing. This provides a count based on number of axles and configuration. The accuracy of this classification count is greatly affected by vehicle speed and roadway geometry. In congested conditions or on curving roadways, accuracy is compromised. Tube counters are also difficult to use safely and reliably in high speed traffic so they are not generally used for counts on freeways.
3. **Inductance loop counters** – Inductance loop counters use electronic inductance loops to detect the motion of a vehicle over the loop. They generally collect information about the length of a vehicle. As in the case of pneumatic tube collectors, algorithms are used to convert the loop signal information into axle bins or configuration bins. These machine counters are purported to be the most accurate for conducting classification counts.
4. **Weigh-in-motion sensors** – WIM stations used by Caltrans provide information about vehicle classification that is also accurate. Classification by number of axles and FHWA classification categories can be accomplished.
5. **Manual classification** – Trained observers can be stationed on a roadside and they can observe many of the characteristics used to classify vehicles (number of axles, body type, configuration). However, the more characteristics that are to be recorded in high volume traffic the more difficult it becomes to count (observer accuracy suffers or more observers are

needed). In addition, it is possible that characteristics such as body type may be miss-classified, especially if the number of classification categories is very large. Consistency between manual counts and machine counts can be an issue.

6. **Video classification** – Video imaging can be used to record truck counts. Video has the advantage of being able to identify all of the characteristics that can be observed visually, can be calibrated to record vehicle lengths, and can be used to record license plate information for checking data against registration records (providing the potential to check variables such as GVW). Video classification is by far the most expensive method available.

WHAT PROBLEMS ARE POSED BY THE VARIOUS CLASSIFICATION SYSTEMS?

- There does not appear to be a one size fits all classification system. If truck data are to be used in emissions models, GVW classification of trucks will be necessary unless the ARB moves to a different approach to estimating emissions. Information about truck body types linked to truck usage could ultimately be more useful for estimating trip generation and distribution in either conventional models or in new commodity-based models. Data on axle loadings is still critical for highway design and determination of maintenance requirements.
- Some vehicle attributes can be measured easily with relative accuracy and some cannot. GVW cannot be measured with machine counters nor can it be observed reliably in manual counts. Number of axles can be reliably observed in manual counts but it cannot be measured directly with machine counters. The reliability of machine counters for observing number of axles is subject to the variations in traffic and roadway conditions.
- Because multiple classification systems will always be in use and because of the difficulties involved in measuring certain vehicle attributes, methods are needed to translate from one measurement system to another. There are two general approaches that can be used to come up with these conversions. Data on vehicle populations that contain information about multiple vehicle characteristics can be used to cross-tabulate the vehicle characteristics. The fractions of vehicles in the population that fall into each cell of this matrix can then be applied to raw count data to allocate the counts among appropriate classification categories. This assumes that the general characteristics of the population are representative of what would be found on any given roadway segment. The second option is to collect data on a sample of vehicle traffic using methods that allow for the collection of information about multiple vehicle attributes. For example, limited road blocks could be set up for short periods of time to stop trucks and ask for information about GVW, number of axles, and body style. We could then use correlations among variables

collected in the sample and apply this to all subsequent traffic count. Samples could be taken by roadway type and geographic area. This approach may be costly and impractical.

WHAT DATA SOURCES ARE AVAILABLE FOR DEVELOPING CONVERSION FACTORS?

1. **Vehicle Inventory and Use Survey (VIUS)** – This is a vehicle population database. Every five years, the Bureau of the Census conducts a statistical survey of truck owners in the U.S. Detailed information about vehicle characteristics and use are collected and tabulated in the survey. Data can be disaggregated by state so it is possible to extract a "California sample." However, it is not possible to disaggregate to the SCAG region. VIUS does provide information about GVW, number of axles, body styles, and vehicle length and these variables can be cross-tabulated. GVW and vehicle length variables are presented in variable ranges that cannot be reset and this presents some problems for developing tabulations that match the ARB weight classes. In VIUS, GVW ranges are as follows: <6000 lbs, 6001 – 10,000 lbs., 10,001 – 14,000 lbs., 14,0001 – 33,000 lbs., >33,000 lbs. It is not possible to use VIUS to determine how many of the 6,001 – 10,000 lb. vehicles are rated below 8500 lbs. and above 8500 lbs.
2. **Department of Motor Vehicles (DMV) Registration Records –** DMV registration records are also a population database that is continuously maintained. The data can be disaggregated by county so that region-specific distributions can be analyzed. DMV does not register vehicles on the basis of GVW (registration is by unladen weight). However, DMV does record the manufacturers vehicle identification number (VIN) and this can be used in concert with other information contained in the registration record to classify vehicles by GVW and body style. To conduct this classification, a VIN decoder is required that includes information from the manufacturers that interprets the VIN. Both the California Energy Commission (CEC) and the ARB routinely receive copies of the DMV registration files and each uses their own VIN decoder and other customized programs to interpret DMV data. The DMV/VIN information does allow for the classification of trucks by GVW and ranges can be set to determine vehicles with GVW less than 8500 lbs. and greater than 8500 lbs. DMV body style categories do not match those of VIUS.
3. **Intercept Survey Data** – Vehicle intercept surveys are being undertaken as part of the SCAG truck count program. These surveys will be conducted on state highways at all of the external cordon locations for the region. Information about truck configuration, number of axles, body style, and GVW can be collected in these surveys and cross-tabulated. These data will

represent a unique set of facilities that may not be representative of vehicle characteristics throughout the region.

WHAT DO THE DATA SHOW?

- Both the VIUS data and the DMV data show that there are a substantial number of pickup trucks and vans that may be classified as trucks based on the 8500 lb. threshold established by ARB. It may be very difficult to distinguish those pickups and vans that are over 8500 lbs. from those that are under 8500 lbs. using either manual or machine count methods. Further, it will be impossible in count programs to distinguish those pickups and vans that are personal use vehicles (trip characteristics collected in household travel surveys) from those that are commercial vehicles (trips estimated in the truck model). According to the DMV data (see Table 1), there are 847,639 standard pickup trucks registered in the LA Region and 272,400 standard vans. Of these, 236,118 of the pickups and 56,262 of the vans are 8501 – 10,000 lbs. GVW. While a relatively small fraction of the total number of pickups and vans, these vehicles represent a large fraction of the total number of trucks that are over 8500 lbs. (over 46%).
- Data from VIUS were used to cross-tabulate number of axles and GVW. This was constrained to the weight classes in VIUS as described above. Only California trucks were included in the cross-tabulation. Pickups and vans were excluded from the cross-tabulation. The results are shown in Table 2. These results show that most trucks with 3 or more axles have a GVW >33,000 lbs. However, 2-axle trucks are spread over every weight class with no particularly good correlation. Thus, using number of axles as a method of classifying and then converting to GVW categories will introduce significant inaccuracies with respect to the allocation of 2-axle trucks.
- Data from VIUS were also used to cross-tabulate vehicle length and GVW (see Table 3). In this cross-tabulation, all trucks were included. The results show that most trucks under 20 feet in length are also under 10,000 lbs. GVW. While only a small percentage of the vehicles that are 16-20 ft. in length are in the 6001 – 10,000 lb. GVW class, this does represent a large number of vehicles relative to the total number of trucks over 8500 lbs. GVW. Most standard pickups and standard vans measure 18 – 20 ft. in length suggesting that a more appropriate cutoff for trucks over 8500 lbs. may be 18 ft. The data also show that vehicle length is not a terribly useful predictor of weight class for trucks >10,000 lbs. GVW.
- There is significant inconsistency between the VIUS data and the DMV data with respect to body style information when cross-tabulated with weight class information. The DMV data as tabulated by the CEC indicates that the only body styles for which there are trucks under 10,000 lbs. GVW are pickups, vans, and SUVs, while the VIUS data indicates a number of other body types.

This raises some questions with respect to how these other body styles might be counted in manual count programs.

WHAT CLASSIFICATION AND COUNT METHODS WOULD BE MOST APPROPRIATE FOR SCAG?

- We recommend accepting the vehicle classification data from the DMV registration files as tabulated by the CEC as a starting point for analysis of vehicle classification options. This data set appears to be the most complete and to have undergone the most scrutiny. Based on analysis of these data, if pickup trucks and vans are eliminated from the counts (and this appears to be possible using both manual and machine counts), then the resulting counts should accurately account for truck traffic for all trucks with a GVW over 10,000 lbs.
- According to ARB, current regulatory standards classify heavy-duty vehicles as any vehicle with a GVW greater than 14,000 lbs. However, the emission models still include a light-heavy category, 8501 – 14,000 lbs. This is further subdivided in the latest models into 8501 – 10,000 and 10,001 – 14,000. In most air districts, where the MPO/RTPA does not have a truck model, the regional travel demand models are used to provide estimates of total VMT and the VMT is allocated to GVW classes based on VMT estimates provided by EMFAC/BURDEN. The EMFAC/BURDEN VMT estimates by weight class are developed using vehicle population estimates (from DMV records) and annual mileage accrual rates (from VIUS). If the SCAG truck model were modified to estimate truck activity for trucks with GVW >10,000 lbs., the same approach could be applied to non-truck VMT obtained from the model in order to allocate this VMT between the weight classes 0 – 8500 lbs. and 8501 – 10,000 lbs. The advantage of this approach would be a more accurate estimate of true truck VMT, excluding pickup trucks and vans from the truck model. Since the trip generation rates in the current model probably do not include pickup trucks (many of these are personal use vehicles and respondents to the survey used to gather trip generation data probably did not include trips by these types of vehicles in their responses), validation to counts that exclude these trucks would yield a more accurate model. This approach should be acceptable to ARB and the AQMD based on our initial discussions with staff.
- Number of axles is probably the most consistent way to count trucks regardless of the technique used to do the counting. The main problem with this approach is in converting counts of 2-axle trucks into GVW categories, which is necessary for emission modeling. There is no good solution to this problem other than to allocate the 2-axle trucks across weight classes based on the population distribution as determined from VIUS data (we are still investigating whether or not it is possible to determine number of axles from

the DMV data). Length bins do not provide a better correlation to weight classes than does number of axles and length cannot be accurately measured in manual counts.

- Counts by number of axles, excluding pickup trucks and vans should provide a reasonably accurate count of trucks over 10,000 lbs. GVW and trucks over 33,000 lbs. GVW. The allocation of trucks to the 10,001 – 14,000 lb. and 14,001 – 33,000 lb. categories will never be very accurate using these methods.
- It may be possible to develop weight class allocation factors for 2-axle trucks that are specific to different facility types (as opposed to using the same population averages for all facilities), if a clear relationship exists between the allocation factors and type of facility. One way of investigating this would be to do a sample of video counts on different types of facilities. The video counts should be used to record license plate information so that accurate vehicle characteristics can be determined from DMV records. This experiment will be expensive and should only be undertaken if it is determined that greater accuracy is required in the allocation of 2-axle trucks with GVW of 10,001 – 33,000 lbs. is required.

Table 1. Vehicles by Body Type and GVW Ratings in the LA Region (Source: DMV 2001)

Vehicle Type	< 6000 lbs	6,001-10,000 lbs	8,501-10,000 lbs	Vehicle Type	Total	10,001-14,000 LBS	14,001-33,000 LBS	33,001+LBS
CAR-MINI	444,353	---	---	AMBULANCE	322	283	39	0
CAR-SUBCOMPACT	1,347,727	---	---	ARMORED TRUCK	419	1	395	23
CAR-COMPACT	1,728,187	---	---	AUTO CARRIER	879	19	845	15
CAR-MIDSIZE	1,596,472	---	---	BEVERAGE	71	1	16	54
CAR-LARGE	517,928	---	---	BOOM	58	18	37	3
CAR-SPORT	807,977	---	---	BUS	23,092	2,518	20,492	82
PICKUP-COMPACT	884,748	---	---	CARGO CUTAWAY	739	649	90	0
VAN-COMPACT	738,015	---	---	CHASSIS & CAB	16,265	8,690	7,448	127
SPT/UT-COMPACT	823,571	---	---	CONCRETE MIXER	2,325	2	32	2,291
SPT/UT-MINI	37,679	---	---	CONVENTIONAL CAB	10,621	174	10,017	430
PICKUP-STD	---	611,521	---	CRANE	2,837	45	1,385	1,407
PICKUP 8,501-10,000	---	236,118	236,118	CUTAWAY	891	715	176	0
VAN-STD	---	216,138	---	DROMEDAY	54	1	5	48
VAN 8,501-10,000	---	56,262	56,262	DUMP	13,290	660	7,774	4,856
SPT/UT-STD	---	301,680	---	FIRE TRUCK	3,063	448	498	2,117
				FLAT BED /PLATFRM	16,701	3,640	11,868	1,193
TOTAL LIGHT DUTY - LA	8,926,657	1,421,719	292,380	FORWARD CONTROL	1,130	246	884	0
TOTAL LIGHT DUTY - CA	19,149,716	3,494,462	766,972	GARBAGE	5,881	83	921	4,877
Pct of LA Region in CA	46.62%	40.68%	38.12%	GLIDERS	57	0	3	54
				INCOMPLTE CHASSIS	564	43	507	14
				LOGGER	25	5	8	12
				MOTORIZED CUTAWAY	216	203	13	0
				MULTIPLE BODIES	137	20	68	49
				PANEL	1,303	1,158	145	0
				PARCEL DELIVERY	449	120	329	0
				PICKUP	6,976	6,953	21	2
				REFRIGERATED	3,575	145	3,317	113
				STAKE OR RACK	14,699	4,223	10,261	215
				STEP VAN	1,038	327	711	0
				TANDEM	2,344	8	6	2,330
				TANK	3,677	29	2,399	1,249
				TILT CAB	6,459	1,849	4,304	306
				TILT TANDEM	1,685	3	15	1,667
				TOW TRUCK WRECKER	3,111	393	2,568	150
				TRACTOR TRUCK DSL	42,293	8	8,512	33,773
				TRACTOR TRUCK GAS	1,124	21	437	666
				UNKNOWN	2,408	1,352	827	229
				UTILITY	8,351	3,811	4,266	274
				VAN	37,544	9,296	27,853	395
				SUBTOTAL	236,673	48,160	129,492	59,021
				MOTORIZED HOME	103,761	81,932	21,814	15
				TOTAL - LA Region	**340,434**	**130,092**	**189,401**	**59,036**
				TOTAL - CA	808,512	311,783	451,426	138,573
				Pct of LA Region in CA	42.11%	41.73%	41.96%	42.60%

Table 2. Vehicles by Axle Category and GVW Ratings (excluding Pickups, SUVs, Station Wagons, Minivans, & Panel/Vans)					
Number of Axles	**< 6000 lbs**	**6,001-10,000 lbs**	**10,001-14,000 lbs**	**14,001-33,000 lbs**	**33,001 + lbs**
2-axles	11.83%	26.36%	14.42%	34.45%	12.91%
(371,974)	(44,023)	(98,088)	(53,672)	(128,165)	(48,026)
3 axles	0%	1.40%	1.44%	11.69%	85.44%
(117,834)	0	(1,669)	(1,708)	(13,772)	(100,684)
4 axles	0%	0%	0%	2.80%	97.14%
(8,582)	0	0	0	(245)	(8,337)

Table 3. Vehicles by GVW Ratings and Vehicle Length					
Vehicle Length	**< 6000 lbs**	**6,001-10,000 lbs**	**10,001-14,000 lbs**	**14,001-33,000 lbs**	**33,001 + lbs**
< 13 ft	100%	0%	0%	0%	0%
(5,702)	(5,702)	(0)	(0)	(0)	(0)
13-16 ft	58.53%	24.85%	9.12%	7.50%	0%
(55,392)	(32421)	(13,765)	(5,052)	(4,154)	0
16-20 ft	93.77%	5.72%	0.29%	0.22%	0.01%
(8,043,823)	(7,542,693)	(460,107)	(23,327)	(17,696)	(804)
20-28 ft	20.49%	21.33%	15.65%	41.68%	0.85%
(153,077)	(31,365)	(32,651)	(23,957)	(63,803)	(1,302)
28-36 ft	1.99%	13.91%	31.09%	50.43%	2.58%
(57,397)	(1,142)	(7,984)	(17,845)	(28,945)	(1,481)
36-41 ft	0%	0%	4.02%	53.96%	42.02%
(8,754)	0	0	(352)	(4,724)	(3,678)
41-45 ft	0%	40.04%	3.32%	40.03%	16.62%
(8,543)	0	(3421)	(284)	(3,420)	(1,420)
45-50 ft	0%	4.40%	4.40%	22.05%	69.16%
(6,440)	0	(283)	(283)	(1,420)	(4,454)
50-55 ft	0%	0%	0%	18.92%	81.12%
(4,502)	0	0	0	(852)	(3,652)

APPENDIX B
FHWA VEHICLE CLASSES WITH DEFINITIONS

1. Motorcycles (Optional) -- All two or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handlebars rather than steering wheels. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheel motorcycles. This vehicle type may be reported at the option of the State.

2. Passenger Cars -- All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.

3. Other Two-Axle, Four-Tire Single Unit Vehicles -- All two-axle, four-tire, vehicles, other than passenger cars. Included in this classification are pickups, panels, vans, and other vehicles such as campers, motor homes, ambulances, hearses, carryalls, and minibuses. Other two-axle, four-tire single-unit vehicles pulling recreational or other light trailers are included in this classification. Because automatic vehicle classifiers have difficulty distinguishing class 3 from class 2, these two classes may be combined into class 2.

4. Buses -- All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or three or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles. Modified buses should be considered to be a truck and should be appropriately classified.

NOTE: In reporting information on trucks the following criteria should be used:

a. Truck tractor units traveling without a trailer will be considered single-unit trucks.
b. A truck tractor unit pulling other such units in a "saddle mount" configuration will be considered one single-unit truck and will be defined only by the axles on the pulling unit.
c. Vehicles are defined by the number of axles in contact with the road. Therefore, "floating" axles are counted only when in the down position.
d. The term "trailer" includes both semi- and full trailers.

5. Two-Axle, Six-Tire, Single-Unit Trucks -- All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., with two axles and dual rear wheels.

6. Three-Axle Single-Unit Trucks -- All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., with three axles.

7. Four or More Axle Single-Unit Trucks -- All trucks on a single frame with four or more axles.

8. Four or Fewer Axle Single-Trailer Trucks -- All vehicles with four or fewer axles consisting of two units, one of which is a tractor or straight truck power unit.

9. Five-Axle Single-Trailer Trucks -- All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power unit.

10. Six or More Axle Single-Trailer Trucks -- All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.

11. Five or fewer Axle Multi-Trailer Trucks -- All vehicles with five or fewer axles consisting of three or more units, one of which is a tractor or straight truck power unit.

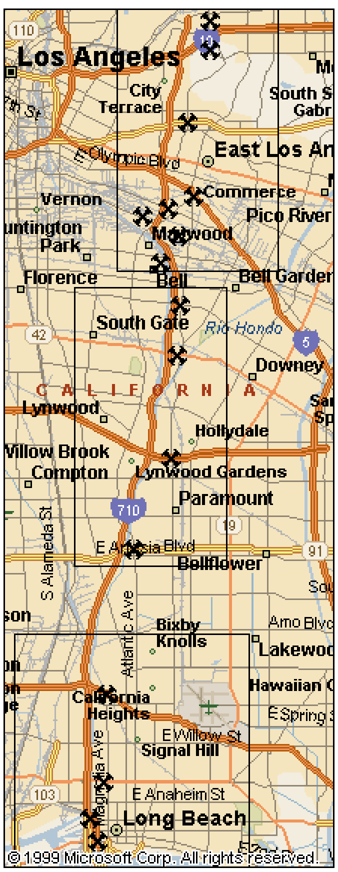
12. Six-Axle Multi-Trailer Trucks -- All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power unit.

13. Seven or More Axle Multi-Trailer Trucks -- All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power unit.

APPENDIX C
SCREENLINE & CLASSIFICATION COUNT LOCATIONS

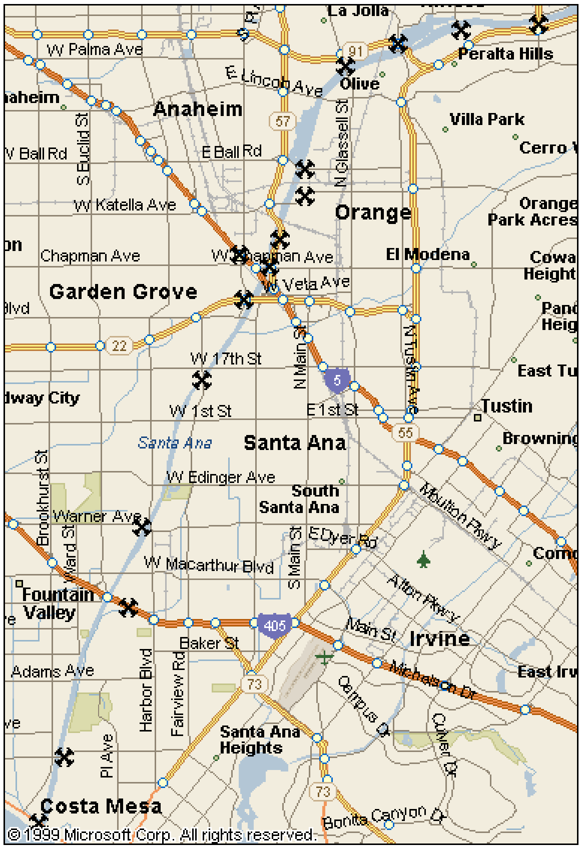
Screenline # 1

Screenline # 2

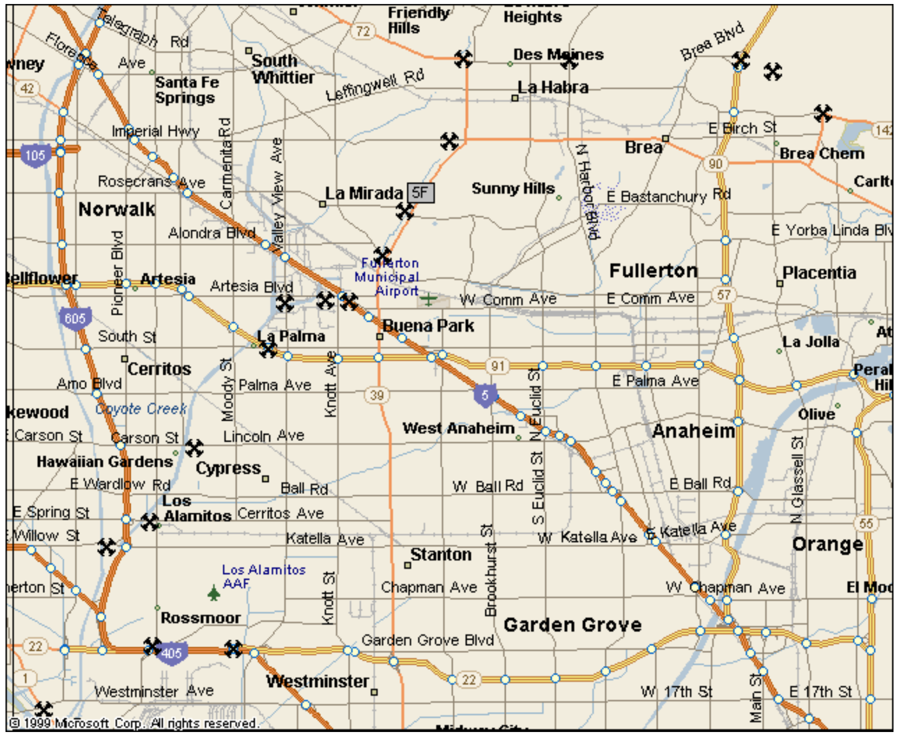


Screenline # 3

Screenline # 4



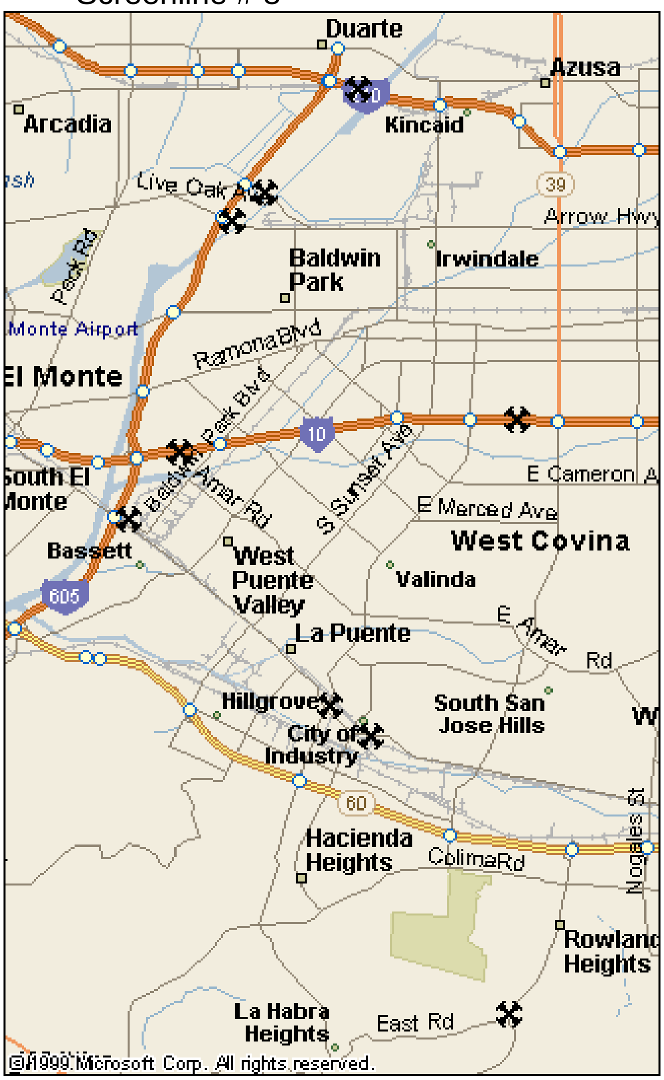
Screenline # 5



Screenline # 6

Screenline # 7

Screenline # 8



Screenline # 9

Screenline # 10

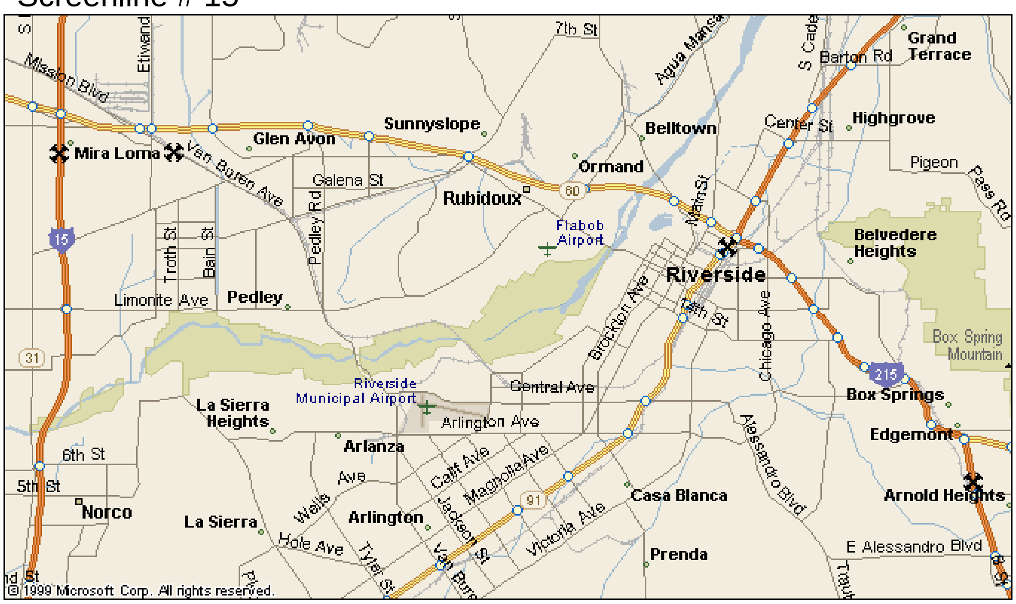
Screenline # 11

Screenline # 12

Screenline # 13

Screenline # 14

Screenline # 15



APPENDIX D
RAW CLASSIFICATION COUNT DATA

SCREENLINES

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #1 Totals

LOCATION #: 1-15

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	24	151	48	44	633	900
0100	18	134	49	41	597	839
0200	20	155	63	46	676	960
0300	21	220	69	52	774	1136
0400	38	439	130	74	913	1594
0500	136	795	191	96	1160	2378
0600	272	1255	228	104	1049	2908
0700	259	1183	239	98	875	2654
0800	191	1506	257	98	1050	3102
0900	184	1584	274	104	1244	3390
1000	145	1796	293	117	1309	3660
1100	109	1816	295	112	1296	3628
1200	123	1989	335	107	1413	3967
1300	155	1933	275	98	1349	3810
1400	233	1914	273	92	1213	3725
1500	272	1708	262	86	962	3290
1600	301	1348	193	69	800	2711
1700	165	1068	146	64	689	2132
1800	141	786	119	53	685	1784
1900	110	663	83	51	703	1610
2000	76	509	62	50	745	1442
2100	57	348	53	56	717	1231
2200	32	244	56	48	723	1103
2300	27	202	60	47	701	1037
TOTAL	3109	23746	4053	1807	22276	54991

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #2 Totals

LOCATION #: 16-37

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	53	428	232	83	1138	1934
0100	48	363	188	74	1147	1820
0200	53	437	193	68	1273	2024
0300	47	566	250	90	1480	2433
0400	74	786	364	88	1907	3219
0500	168	1656	520	167	2632	5143
0600	333	3087	1003	244	3323	7990
0700	297	3241	905	246	3213	7902
0800	314	3863	1010	266	3941	9394
0900	260	4420	1115	306	4871	10972
1000	175	4427	1051	266	5323	11242
1100	185	4533	1068	275	5197	11258
1200	198	4377	1168	363	5078	11184
1300	245	4408	1125	343	4554	10675
1400	281	4367	1107	299	4054	10108
1500	334	3770	1007	260	3204	8575
1600	366	3096	880	224	2615	7181
1700	291	2138	703	203	2030	5365
1800	266	1602	603	179	1760	4410
1900	188	1097	384	133	1650	3452
2000	122	920	336	129	1521	3028
2100	90	636	272	115	1445	2558
2200	70	379	236	56	1253	1994
2300	55	416	230	72	1187	1960
TOTAL	4513	55013	15950	4549	65796	145821

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #3 Totals

LOCATION #: 38-47

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	9	125	107	50	394	685
0100	17	128	107	34	471	757
0200	7	147	112	42	527	835
0300	12	229	148	57	682	1128
0400	33	340	212	48	715	1348
0500	167	747	314	83	1101	2412
0600	282	1462	509	135	1394	3782
0700	174	1496	536	125	1519	3850
0800	211	1819	596	132	2085	4843
0900	188	2035	688	160	2668	5739
1000	110	2184	711	170	2991	6166
1100	133	2197	571	204	2872	5977
1200	158	2188	615	185	2841	5987
1300	215	2278	564	182	2697	5936
1400	228	2172	545	184	2434	5563
1500	214	2039	514	146	2026	4939
1600	219	1556	412	136	1578	3901
1700	189	1141	382	124	1125	2961
1800	155	851	307	85	920	2318
1900	107	625	227	69	794	1822
2000	76	492	199	63	791	1621
2100	56	360	163	49	689	1317
2200	29	214	130	63	484	920
2300	22	176	130	57	479	864
TOTAL	3011	27001	8799	2583	34277	75671

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #4 Totals

LOCATION #: 48-68

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	12	194	100	65	545	916
0100	10	180	81	47	557	875
0200	6	233	88	64	638	1029
0300	19	335	124	79	760	1317
0400	54	564	166	124	941	1849
0500	110	1521	355	229	1320	3535
0600	171	2781	640	272	1548	5412
0700	153	3109	574	309	1433	5578
0800	197	3220	566	255	1750	5988
0900	196	3715	683	260	2237	7091
1000	175	3705	696	237	2219	7032
1100	152	3659	676	244	2081	6812
1200	143	3266	644	256	2163	6472
1300	193	3920	700	247	2023	7083
1400	181	3951	605	247	1709	6693
1500	221	3769	581	227	1393	6191
1600	191	2721	412	145	982	4451
1700	178	1856	264	146	725	3169
1800	126	1381	209	119	664	2499
1900	99	932	153	86	657	1927
2000	62	664	127	53	634	1540
2100	51	471	93	68	587	1270
2200	48	336	69	61	633	1147
2300	42	267	79	57	578	1023
TOTAL	2790	46750	8685	3897	28777	90899

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #5 Totals

LOCATION #: 69-90

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	11	142	54	41	539	787
0100	3	137	82	41	572	835
0200	8	174	61	47	702	992
0300	12	331	85	64	967	1459
0400	33	696	182	105	1370	2386
0500	64	1341	326	171	1935	3837
0600	109	1877	441	254	2117	4798
0700	124	2160	410	202	1978	4874
0800	121	2453	460	271	2467	5772
0900	118	2612	489	282	2980	6481
1000	117	3010	555	301	3250	7233
1100	103	3180	542	263	3283	7371
1200	91	2927	585	261	3129	6993
1300	92	3034	541	272	2949	6888
1400	94	3066	542	214	2631	6547
1500	107	2942	531	222	2244	6046
1600	131	2309	409	197	1722	4768
1700	108	1703	313	167	1387	3678
1800	104	1212	215	125	1233	2889
1900	80	793	175	103	1049	2200
2000	60	533	108	52	855	1608
2100	45	373	101	46	841	1406
2200	36	245	87	47	744	1159
2300	27	191	70	55	584	927
TOTAL	1798	37441	7364	3803	41528	91934

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #6 Totals

LOCATION #: 91-98

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	13	133	82	50	1018	1296
0100	7	105	60	57	998	1227
0200	7	140	96	77	1138	1458
0300	16	233	142	134	1598	2123
0400	32	516	219	159	2050	2976
0500	34	739	282	189	2234	3478
0600	47	1129	368	188	2036	3768
0700	43	1210	323	216	2225	4017
0800	45	1348	344	201	2519	4457
0900	72	1537	431	229	3061	5330
1000	48	1645	443	228	3028	5392
1100	50	1732	509	239	3128	5658
1200	50	1681	477	206	3305	5719
1300	70	1845	483	233	3139	5770
1400	63	1830	448	222	2997	5560
1500	66	1841	433	206	2644	5190
1600	54	1667	362	197	2263	4543
1700	44	1201	313	141	1825	3524
1800	38	905	220	122	2673	3958
1900	37	738	193	78	1485	2531
2000	30	409	168	84	1463	2154
2100	19	281	177	80	1252	1809
2200	20	211	118	62	1260	1671
2300	17	151	108	72	1186	1534
TOTAL	922	23227	6799	3670	50525	85143

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #7 Totals

LOCATION #: 99-111

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	7	54	76	38	715	890
0100	2	56	88	24	705	875
0200	1	68	67	41	831	1008
0300	11	100	138	66	969	1284
0400	9	197	219	75	1364	1864
0500	9	292	269	106	1453	2129
0600	51	689	337	163	1533	2777
0700	83	989	447	161	1603	3287
0800	93	1044	417	189	1889	3634
0900	59	1165	419	201	2088	3932
1000	43	1103	460	167	2265	4044
1100	70	1117	475	158	2198	4020
1200	60	1101	457	199	2044	3861
1300	65	1027	423	202	2133	3850
1400	82	1133	550	153	1933	3851
1500	108	937	423	165	1646	3279
1600	59	736	402	141	1446	2784
1700	49	597	309	131	1229	2315
1800	27	470	266	105	1049	1917
1900	35	365	206	99	975	1680
2000	22	274	151	79	896	1422
2100	15	196	135	88	820	1254
2200	7	69	80	20	665	841
2300	11	60	101	31	697	900
TOTAL	978	13839	6915	2802	33146	57698

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #8 Totals

LOCATION #: 112-123

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	21	126	89	45	844	1125
0100	19	140	89	41	870	1159
0200	12	176	106	60	904	1258
0300	18	219	122	70	969	1398
0400	40	338	203	70	1108	1759
0500	66	786	400	105	1521	2878
0600	111	1513	711	136	1864	4335
0700	144	1520	500	141	1939	4244
0800	165	1677	436	154	2225	4657
0900	158	2076	585	177	2891	5887
1000	102	2198	574	194	3091	6159
1100	79	2004	589	188	3188	6048
1200	91	1887	563	176	3125	5842
1300	75	2109	530	186	2879	5779
1400	84	2002	506	165	2607	5364
1500	93	1920	486	173	1914	4586
1600	126	1709	349	153	1590	3927
1700	110	1187	286	136	1288	3007
1800	90	894	225	83	1210	2502
1900	75	559	225	87	1216	2162
2000	56	357	139	67	1146	1765
2100	51	289	148	72	1084	1644
2200	30	220	136	48	1088	1522
2300	24	135	86	40	875	1160
TOTAL	1840	26041	8083	2767	41436	80167

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #9 Totals

LOCATION #: 124-131

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	6	60	18	12	372	468
0100	6	57	11	19	368	461
0200	8	51	10	12	392	473
0300	9	59	22	17	441	548
0400	21	112	33	21	530	717
0500	25	179	53	36	573	866
0600	37	307	87	51	570	1052
0700	31	369	96	59	599	1154
0800	41	434	130	52	641	1298
0900	41	519	141	73	729	1503
1000	37	497	148	82	761	1525
1100	47	459	145	69	763	1483
1200	31	452	134	71	780	1468
1300	45	473	140	84	777	1519
1400	43	552	139	76	798	1608
1500	39	380	123	83	791	1416
1600	42	466	120	67	795	1490
1700	22	381	96	62	630	1191
1800	34	264	74	39	673	1084
1900	34	200	60	30	631	955
2000	21	142	45	23	599	830
2100	14	93	31	21	550	709
2200	16	93	36	20	513	678
2300	11	56	25	16	454	562
TOTAL	661	6655	1917	1095	14730	25058

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #10 Totals

LOCATION #: 132-137

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	6	310	81	11	404	812
0100	13	343	82	21	412	871
0200	13	282	69	23	373	760
0300	11	325	55	24	333	748
0400	5	374	72	24	316	791
0500	16	400	86	25	404	931
0600	16	477	73	28	333	927
0700	14	450	54	25	368	911
0800	27	440	53	27	362	909
0900	17	404	62	21	502	1006
1000	17	383	76	37	530	1043
1100	15	400	61	27	516	1019
1200	9	421	63	34	517	1044
1300	12	373	57	29	413	884
1400	15	351	61	29	409	865
1500	9	376	70	34	409	898
1600	10	338	55	32	360	795
1700	15	336	57	28	393	829
1800	15	364	78	34	390	881
1900	11	330	66	28	319	754
2000	12	261	54	30	345	702
2100	14	244	50	25	376	709
2200	14	270	70	19	391	764
2300	8	262	85	10	399	764
TOTAL	314	8514	1590	625	9574	20617

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #11 Totals

LOCATION #: 138-142

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	5	37	20	4	180	246
0100	4	30	13	3	170	220
0200	1	23	7	3	172	206
0300	2	17	5	11	159	194
0400	1	73	20	9	174	277
0500	11	199	54	21	325	610
0600	36	435	70	37	311	889
0700	39	475	84	32	393	1023
0800	32	512	74	47	422	1087
0900	33	544	79	42	502	1200
1000	21	554	79	32	558	1244
1100	22	531	97	33	573	1256
1200	20	611	86	27	615	1359
1300	19	586	98	39	494	1236
1400	35	582	99	35	524	1275
1500	43	649	70	33	446	1241
1600	17	482	65	32	367	963
1700	20	321	29	18	272	660
1800	22	225	42	15	224	528
1900	11	173	9	3	203	399
2000	6	110	16	5	199	336
2100	5	80	8	4	183	280
2200	7	51	9	3	199	269
2300	1	33	13	8	167	222
TOTAL	413	7333	1146	496	7832	17220

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #12 Totals

LOCATION #: 143-145

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	6	22	15	3	448	494
0100	9	21	13	1	426	470
0200	7	29	8	0	391	435
0300	5	27	7	0	379	418
0400	9	118	12	0	356	495
0500	12	153	17	5	404	591
0600	7	185	16	3	400	611
0700	10	205	22	6	368	611
0800	9	232	22	6	394	663
0900	14	204	20	5	405	648
1000	11	188	33	4	528	764
1100	12	151	23	7	451	644
1200	14	162	24	7	586	793
1300	12	161	27	10	521	731
1400	10	198	34	7	565	814
1500	10	157	19	8	575	769
1600	14	129	19	10	525	697
1700	17	92	15	8	485	617
1800	11	72	11	3	487	584
1900	17	56	5	0	469	547
2000	17	45	5	0	508	575
2100	9	38	2	0	545	594
2200	12	39	7	0	514	572
2300	4	25	7	8	466	510
TOTAL	258	2709	383	101	11196	14647

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #13 Totals

LOCATION #: 146-149

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	5	42	5	4	417	473
0100	2	46	9	2	403	462
0200	3	48	6	3	466	526
0300	5	90	11	11	486	603
0400	6	117	11	8	533	675
0500	7	258	21	14	501	801
0600	6	323	21	12	495	857
0700	15	178	31	10	488	722
0800	21	173	26	11	526	757
0900	25	169	26	22	554	796
1000	24	277	28	16	517	862
1100	17	282	22	25	683	1029
1200	15	277	35	18	659	1004
1300	14	308	26	15	657	1020
1400	21	299	25	18	571	934
1500	16	210	31	13	638	908
1600	19	190	28	9	663	909
1700	19	169	32	7	582	809
1800	11	141	20	12	584	768
1900	13	243	15	6	509	786
2000	7	177	6	8	514	712
2100	5	134	7	7	484	637
2200	9	118	6	7	446	586
2300	6	73	11	2	399	491
TOTAL	291	4342	459	260	12775	18127

SOUTHLAND CAR COUNTERS

LOCATION: Screenline #15 Totals

LOCATION #: 156-162

OBSERVED BY: SOUTHLAND CAR COUNTERS

TIME BEGIN	B	2	3	4	5+	TOTAL
2400	1	47	41	6	211	306
0100	4	43	38	9	231	325
0200	2	45	30	12	236	325
0300	3	97	39	24	338	501
0400	4	136	78	34	399	651
0500	6	310	156	44	562	1078
0600	19	532	164	98	602	1415
0700	9	674	169	96	844	1792
0800	23	659	164	86	808	1740
0900	23	557	145	81	753	1559
1000	21	538	144	88	795	1586
1100	18	618	148	112	814	1710
1200	23	669	125	83	820	1720
1300	23	575	149	83	813	1643
1400	10	691	178	111	740	1730
1500	31	678	164	93	694	1660
1600	14	562	115	60	542	1293
1700	21	380	87	44	456	988
1800	15	258	58	35	412	778
1900	5	151	49	29	329	563
2000	4	128	46	32	296	506
2100	5	86	34	36	260	421
2200	2	65	33	27	246	373
2300	0	48	36	14	214	312
TOTAL	286	8547	2390	1337	12415	24975

INTERCEPT SURVEY LOCATIONS

SOUTHLAND CAR COUNTERS

LOCATION: 101 @ SANTA BARBARA CO. LINE N/O BATES RD.

DATE: 11/15/01 DAY: THURSDAY LOCATION #: 1

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: NORTH DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	2	2	0	0	25						29
0100	0	7	3	3	36						49
0200	1	3	1	0	39						44
0300	0	8	4	1	47						60
0400	2	19	4	2	56						83
0500	3	54	15	5	95						172
0600	3	150	26	8	109						296
0700	4	167	25	9	72						277
0800	4	95	15	6	57						177
0900	3	93	10	4	51						161
1000	4	112	17	5	67						205
1100	2	101	21	6	90						220
1200	3	72	18	6	104						203
1300	3	87	13	4	93						200
1400	6	58	12	3	102						181
1500	7	66	5	4	80						162
1600	2	48	3	1	51						105
1700	5	37	4	3	49						98
1800	6	29	3	3	32						73
1900	4	21	2	1	37						65
2000	2	16	1	2	32						53
2100	5	10	2	1	46						64
2200	3	6	1	2	29						41
2300	3	2	3	1	35						44
TOTAL	77	1263	208	80	1434	0	0	0	0	0	3062

SOUTHLAND CAR COUNTERS

LOCATION: 101 @ SANTA BARBARA CO. LINE N/O BATES RD.

DATE: 11/15/01 DAY: THURSDAY LOCATION #: 2

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: DIRECTION: SOUTH

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400						1	6	1	1	45	54
0100						0	9	1	1	31	42
0200						0	11	1	0	32	44
0300						0	9	1	0	21	31
0400						3	4	3	1	40	51
0500						4	15	2	1	33	55
0600						3	33	6	5	35	82
0700						3	46	6	3	44	102
0800						5	67	7	6	55	140
0900						3	45	13	3	80	144
1000						5	67	14	8	92	186
1100						4	91	19	7	107	228
1200						5	122	15	6	100	248
1300						3	121	16	15	84	239
1400						7	139	24	6	68	244
1500						4	157	26	7	72	266
1600						5	141	17	10	46	219
1700						4	87	8	3	69	171
1800						4	44	2	2	61	113
1900						3	27	2	1	57	90
2000						2	19	3	0	52	76
2100						2	16	2	1	53	74
2200						3	4	3	2	64	76
2300						2	6	0	1	48	57
TOTAL	0	0	0	0	0	75	1286	192	90	1389	3032

SOUTHLAND CAR COUNTERS

LOCATION: SR-14 L.A./ KERN CO. LINE N/O AVENUE A

DATE: 11/20/01 DAY: TUESDAY LOCATION #: 3

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: NORTH DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	0	3	0	0	13						16
0100	0	1	0	1	18						20
0200	0	2	0	0	20						22
0300	0	7	1	0	27						35
0400	0	13	4	0	23						40
0500	0	17	0	0	29						46
0600	0	26	2	3	27						58
0700	1	28	3	1	30						63
0800	2	33	2	2	23						62
0900	1	14	3	7	36						61
1000	0	17	4	6	43						70
1100	0	19	5	4	48						76
1200	2	19	2	1	44						68
1300	0	34	3	0	49						86
1400	1	16	6	4	46						73
1500	2	24	3	0	38						67
1600	1	11	2	1	34						49
1700	0	11	3	1	25						40
1800	0	10	0	0	19						29
1900	0	7	0	0	25						32
2000	1	3	0	1	34						39
2100	0	2	0	0	19						21
2200	0	2	0	0	23						25
2300	0	1	0	1	19						21
TOTAL	11	320	43	33	712	0	0	0	0	0	1119

SOUTHLAND CAR COUNTERS

LOCATION: SR-14 L.A./ KERN CO. LINE N/O AVENUE A

DATE: 11/20/01 DAY: TUESDAY LOCATION #: 4

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: NORTH DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400						0	2	0	0	26	28
0100						0	4	0	1	27	32
0200						0	3	1	0	27	31
0300						0	3	0	0	35	38
0400						0	2	0	0	49	51
0500						0	4	0	0	37	41
0600						0	7	7	0	40	54
0700						1	14	2	0	40	57
0800						3	18	3	0	35	59
0900						0	21	2	2	43	68
1000						0	16	4	2	47	69
1100						0	17	3	1	41	62
1200						0	18	4	1	38	61
1300						2	47	4	1	27	81
1400						2	25	4	1	27	59
1500						1	41	2	3	36	83
1600						0	26	2	1	33	62
1700						1	15	4	0	42	62
1800						0	13	1	1	26	41
1900						0	6	0	0	27	33
2000						0	2	0	0	25	27
2100						1	2	1	1	21	26
2200						1	1	0	0	27	29
2300						0	2	0	0	23	25
TOTAL	0	0	0	0	0	12	309	44	15	799	1179

SOUTHLAND CAR COUNTERS

LOCATION: SR-58 SAN BERNANDINO CO. LINE E/O BORON REST AREA

DATE: 11/13/01 DAY: TUESDAY LOCATION #: 5

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: EAST DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	1	1	0	0	90						92
0100	0	0	0	0	95						95
0200	0	0	1	2	96						99
0300	0	2	2	0	89						93
0400	0	1	0	0	114						115
0500	1	5	0	1	131						138
0600	1	7	1	1	149						159
0700	0	3	0	6	132						141
0800	0	7	0	2	143						152
0900	5	7	2	3	131						148
1000	1	13	0	0	146						160
1100	0	14	5	1	155						175
1200	0	5	2	1	166						174
1300	3	16	2	2	176						199
1400	4	14	3	6	213						240
1500	6	15	3	2	196						222
1600	2	17	4	0	213						236
1700	0	7	5	4	172						188
1800	0	6	0	2	146						154
1900	3	9	1	0	139						152
2000	1	4	2	0	132						139
2100	3	3	1	1	145						153
2200	0	5	0	1	108						114
2300	1	2	2	0	93						98
TOTAL	32	163	36	35	3370	0	0	0	0	0	3636

SOUTHLAND CAR COUNTERS

LOCATION: SR-58 @ SAN BERNANDINO CO. LINE E/O BORON REST AREA

DATE: 11/13/01 DAY: TUESDAY LOCATION #: 6

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: DIRECTION: WEST

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400						0	6	0	0	47	53
0100						0	3	0	0	52	55
0200						0	0	0	0	51	51
0300						0	2	0	0	48	50
0400						0	2	1	0	76	79
0500						0	4	0	0	81	85
0600						2	9	0	3	71	85
0700						1	8	0	1	82	92
0800						1	16	1	0	83	101
0900						2	8	1	1	92	104
1000						1	6	0	3	92	102
1100						1	15	1	5	102	124
1200						4	14	4	2	91	115
1300						2	7	3	4	98	114
1400						2	8	1	0	116	127
1500						2	7	1	0	84	94
1600						0	8	3	1	111	123
1700						0	6	0	2	127	135
1800						1	8	0	2	118	129
1900						1	8	0	0	119	128
2000						0	4	0	1	107	112
2100						1	3	0	0	99	103
2200						0	3	0	0	56	59
2300						0	1	0	0	41	42
TOTAL	0	0	0	0	0	21	156	16	25	2044	2262

SOUTHLAND CAR COUNTERS

LOCATION: I-15 E/O CALICO RD.

DATE: 11/06/01 DAY: TUESDAY LOCATION #: 7

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: EAST DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	1	4	1	2	79						87
0100	1	3	0	3	103						110
0200	1	5	0	2	111						119
0300	1	8	0	5	146						160
0400	0	8	2	7	168						185
0500	0	13	3	5	141						162
0600	0	9	3	3	144						159
0700	0	9	2	4	131						146
0800	2	14	2	2	112						132
0900	2	15	2	3	100						122
1000	4	11	3	1	86						105
1100	10	15	2	2	103						132
1200	9	26	1	4	140						180
1300	7	22	3	4	127						163
1400	4	13	4	4	145						170
1500	3	8	1	5	177						194
1600	6	10	1	4	157						178
1700	5	8	2	2	154						171
1800	4	6	4	2	149						165
1900	2	10	2	1	154						169
2000	0	15	5	3	127						150
2100	3	15	3	1	140						162
2200	2	6	5	1	104						118
2300	3	6	1	1	109						120
TOTAL	70	259	52	71	3107	0	0	0	0	0	3559

SOUTHLAND CAR COUNTERS

LOCATION: I-10 E/O DILLON RD.

DATE: 11/08/01 DAY: THURSDAY LOCATION #: 8

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: EAST DIRECTION:

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	2	9	3	2	180						196
0100	1	5	2	2	181						191
0200	1	3	2	0	133						139
0300	1	8	1	1	104						115
0400	2	5	3	2	112						124
0500	4	6	1	1	117						129
0600	1	10	2	2	109						124
0700	1	15	3	2	101						122
0800	0	16	2	5	127						150
0900	0	9	4	2	112						127
1000	1	5	0	1	109						116
1100	2	8	4	3	118						135
1200	1	10	2	2	139						154
1300	1	3	1	5	168						178
1400	2	16	7	3	187						215
1500	0	9	3	3	225						240
1600	4	12	5	2	203						226
1700	1	7	2	3	198						211
1800	1	7	4	1	217						230
1900	0	6	2	3	203						214
2000	2	8	4	4	238						256
2100	2	5	3	5	261						276
2200	2	5	3	3	239						252
2300	2	2	1	5	179						189
TOTAL	34	189	64	62	3960	0	0	0	0	0	4309

SOUTHLAND CAR COUNTERS

LOCATION: SR-86/78 W/O FORRESTER RD.

DATE: 11/08/01 DAY: THURSDAY LOCATION # 9

OBSERVED BY: SOUTHLAND CAR COUNTERS

DIRECTION: NORTH DIRECTION: SOUTH

TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400	1	2	2	0	30						35
0100	0	0	0	0	38						38
0200	0	2	0	0	37						39
0300	0	4	1	0	25						30
0400	1	3	0	0	31						35
0500	2	4	4	0	35						45
0600	1	13	1	1	40						56
0700	0	11	2	0	48						61
0800	0	8	3	3	54						68
0900	0	5	2	3	39						49
1000	1	12	0	3	50						66
1100	0	11	3	2	42						58
1200	0	8	3	1	43						55
1300	0	8	0	1	39						48
1400	0	5	1	3	52						61
1500	3	11	3	3	45						65
1600	1	9	4	0	52						66
1700	0	4	1	0	54						59
1800	0	3	2	0	37						42
1900	1	4	1	1	42						49
2000	1	2	1	0	30						34
2100	1	2	0	0	32						35
2200	0	1	0	0	28						29
2300	0	1	0	0	27						28
TOTAL	13	133	34	21	950						1151

SOUTHLAND CAR COUNTERS

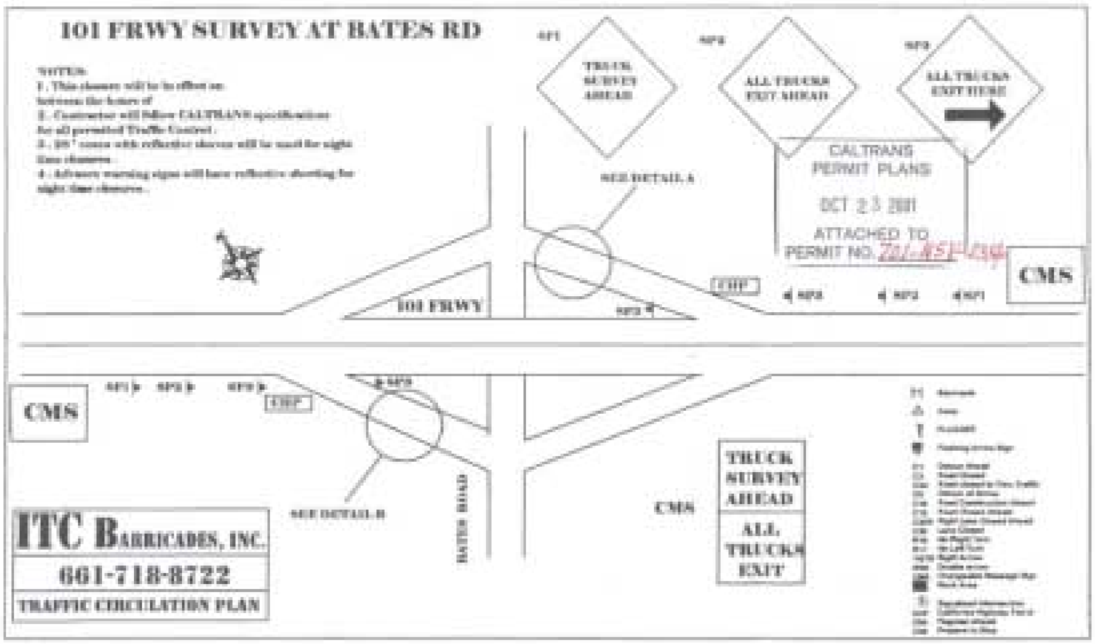
LOCATION: SR-86/78 W/O FORRESTER RD.

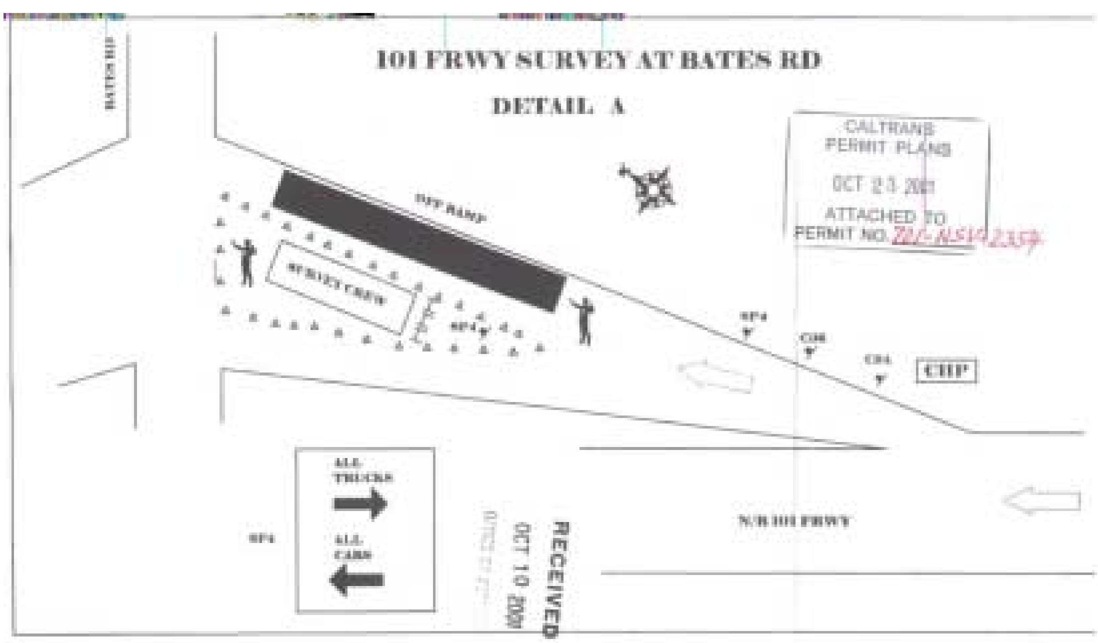
DATE: 11/08/01 DAY: THURSDAY LOCATION #: 10

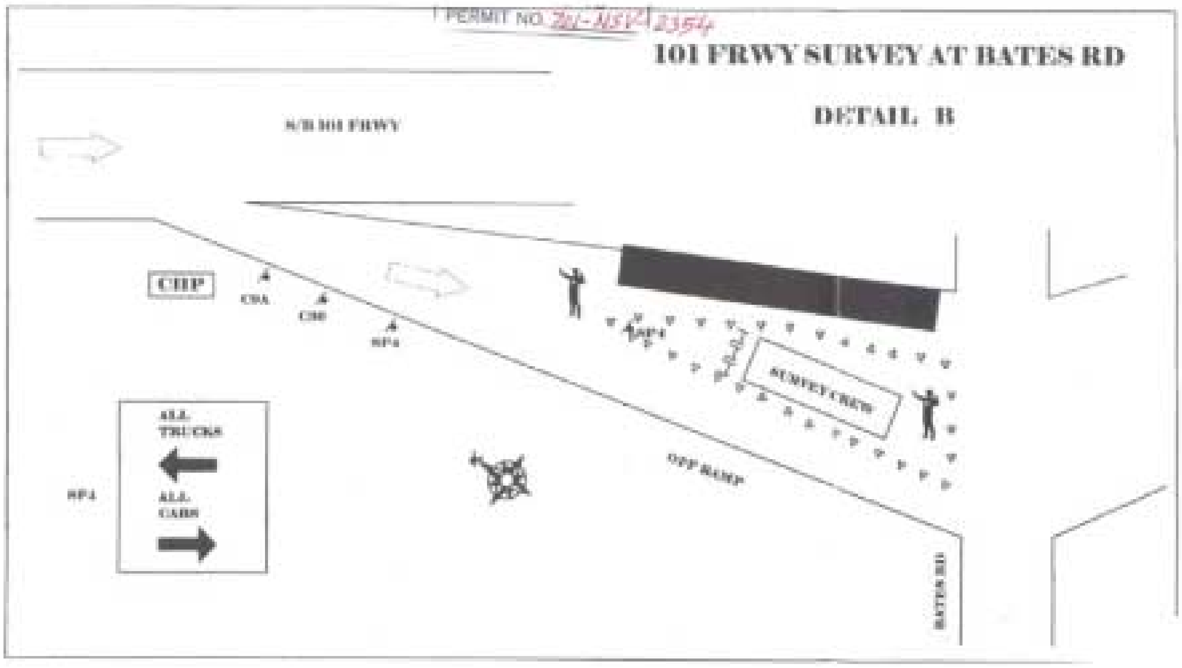
OBSERVED BY: SOUTHLAND CAR COUNTERS

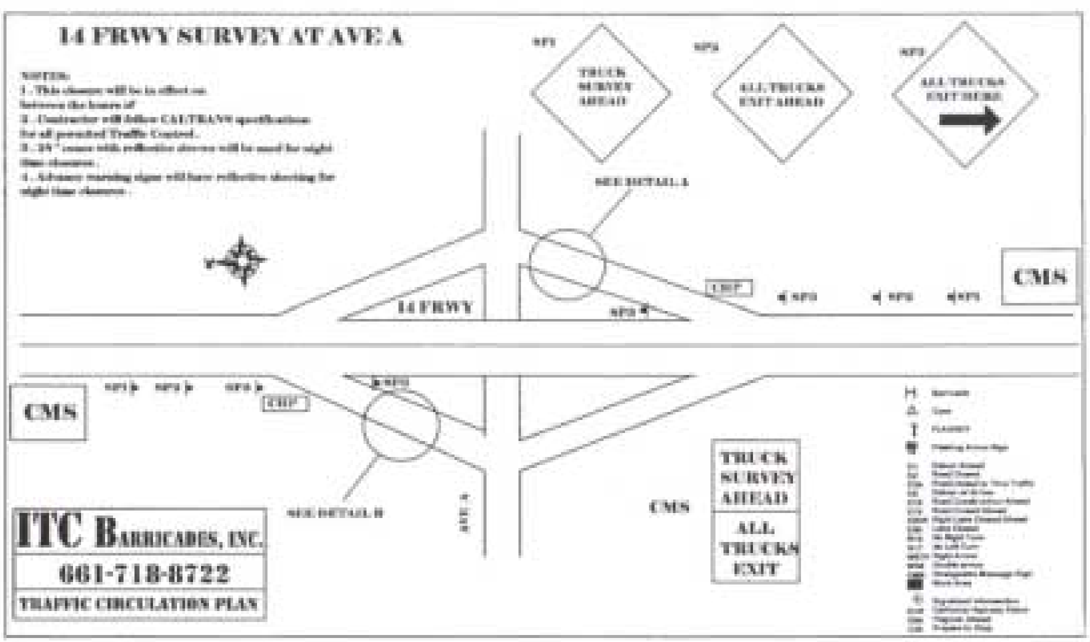
	DIRECTION: NORTH					DIRECTION: SOUTH					
TIME BEGIN	B	2	3	4	5+	B	2	3	4	5+	TOTAL
2400						1	2	2	0	30	35
0100						0	0	0	0	38	38
0200						0	2	0	0	37	39
0300						0	4	1	0	25	30
0400						1	3	0	0	31	35
0500						2	4	4	0	35	45
0600						1	13	1	1	40	56
0700						0	11	2	0	48	61
0800						0	8	3	3	54	68
0900						0	5	2	3	39	49
1000						1	12	0	3	50	66
1100						0	11	3	2	52	68
1200						0	8	3	1	43	55
1300						0	8	0	1	39	48
1400						0	5	1	3	52	61
1500						3	11	3	3	45	65
1600						1	9	4	0	52	66
1700						0	4	1	0	54	59
1800						0	3	2	0	37	42
1900						1	4	1	1	42	49
2000						1	2	1	0	36	40
2100						1	2	0	0	32	35
2200						0	1	0	0	28	29
2300						0	1	0	0	27	28
TOTAL	0	0	0	0	0	13	133	34	21	966	1167

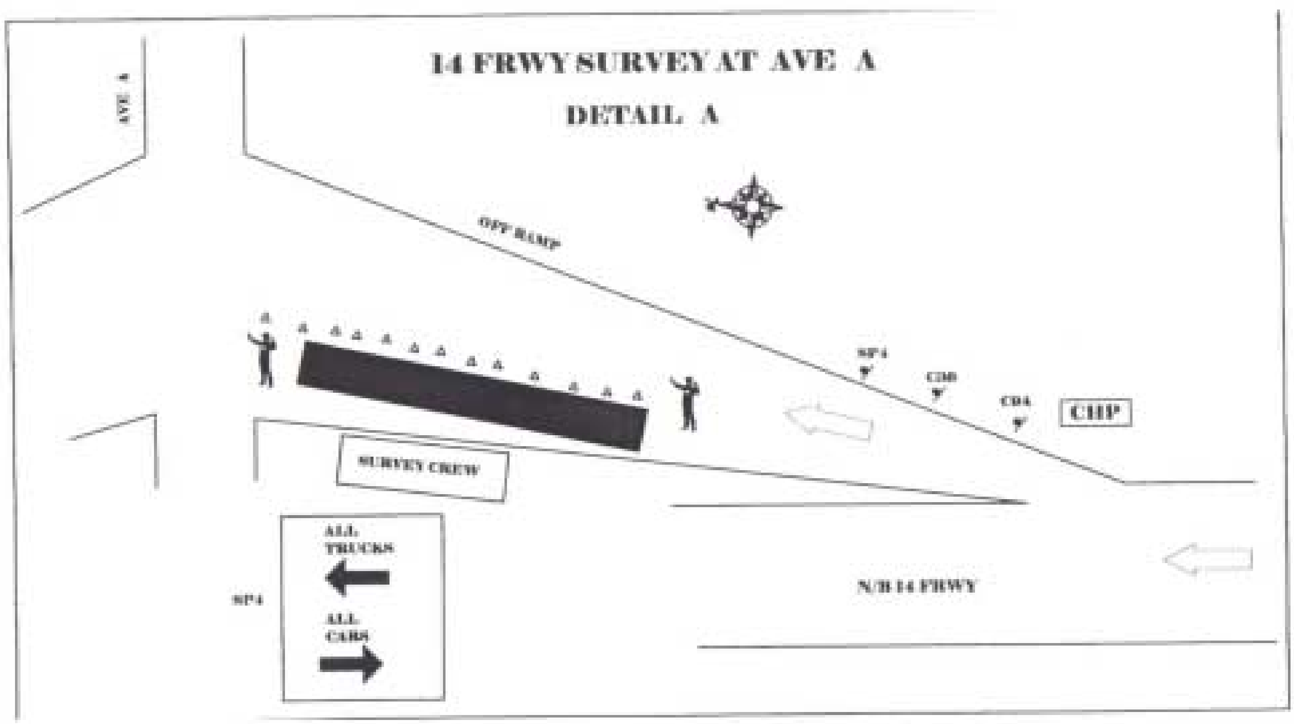
APPENDIX E
EXTERNAL INTERCEPT SURVEY TRAFFIC CONTROL PLANS

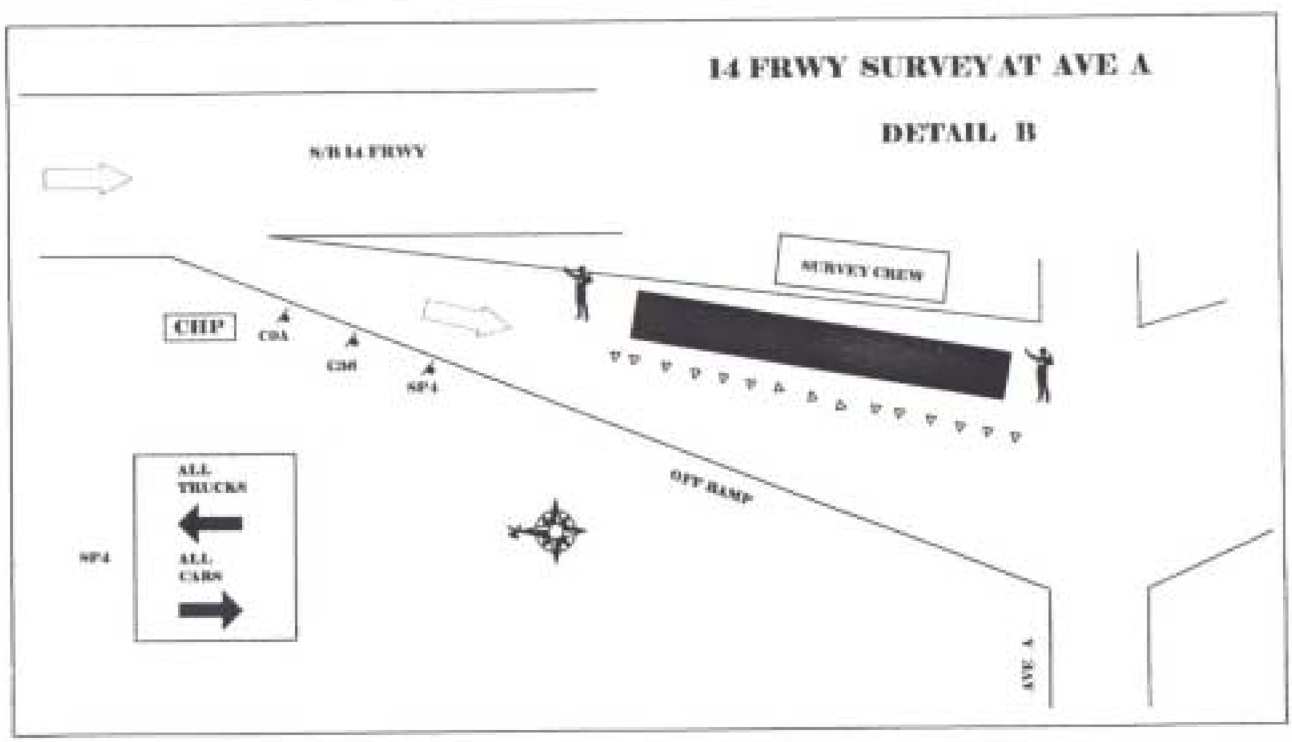


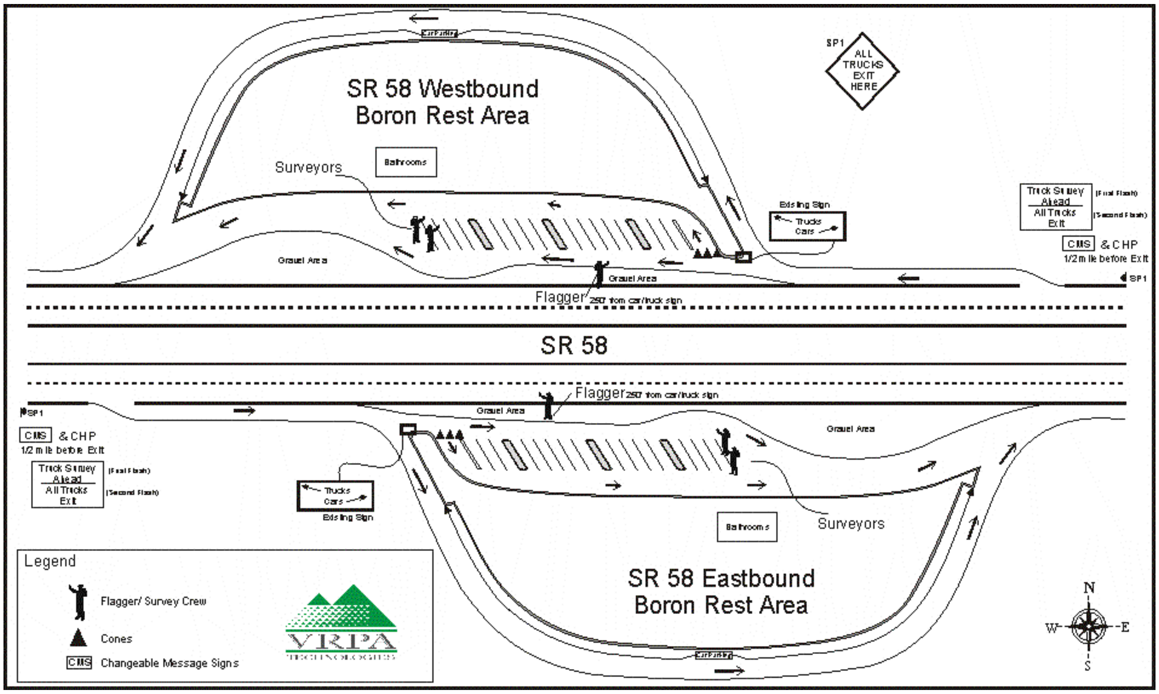


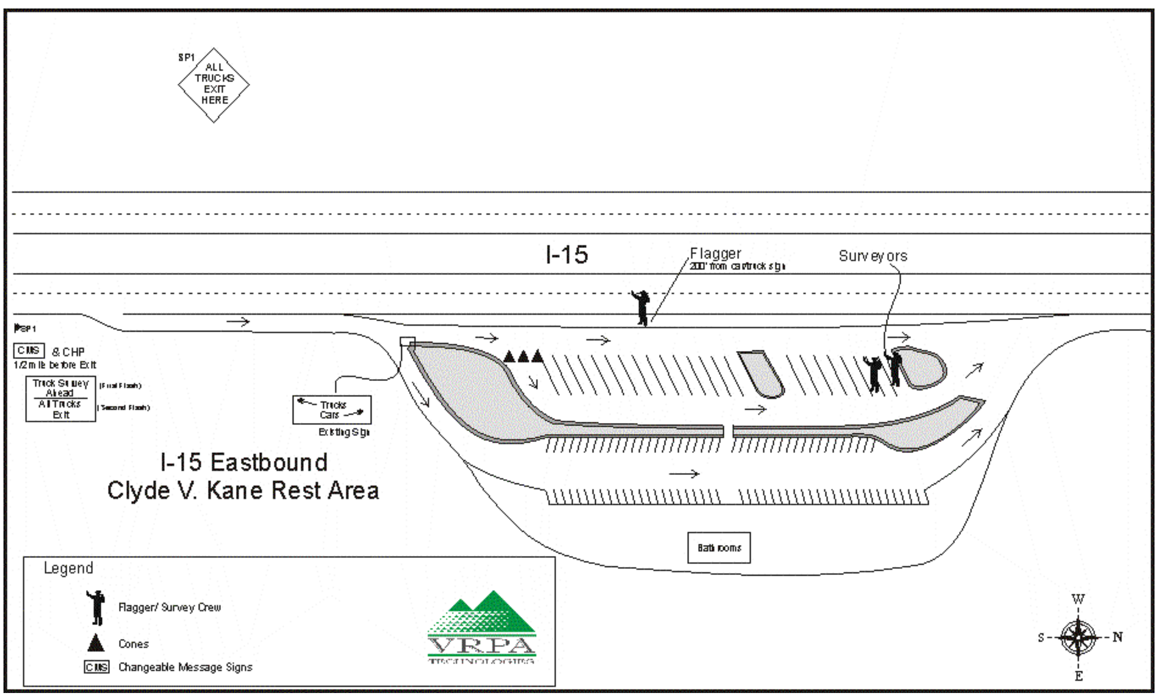

101 FRWY SURVEY AT BATES RD
DETAIL B
S/B 101 FRWY
CHP
SURVEY CREW
ALL TRUCKS
ALL CARS
OFF RAMP
BATES RD

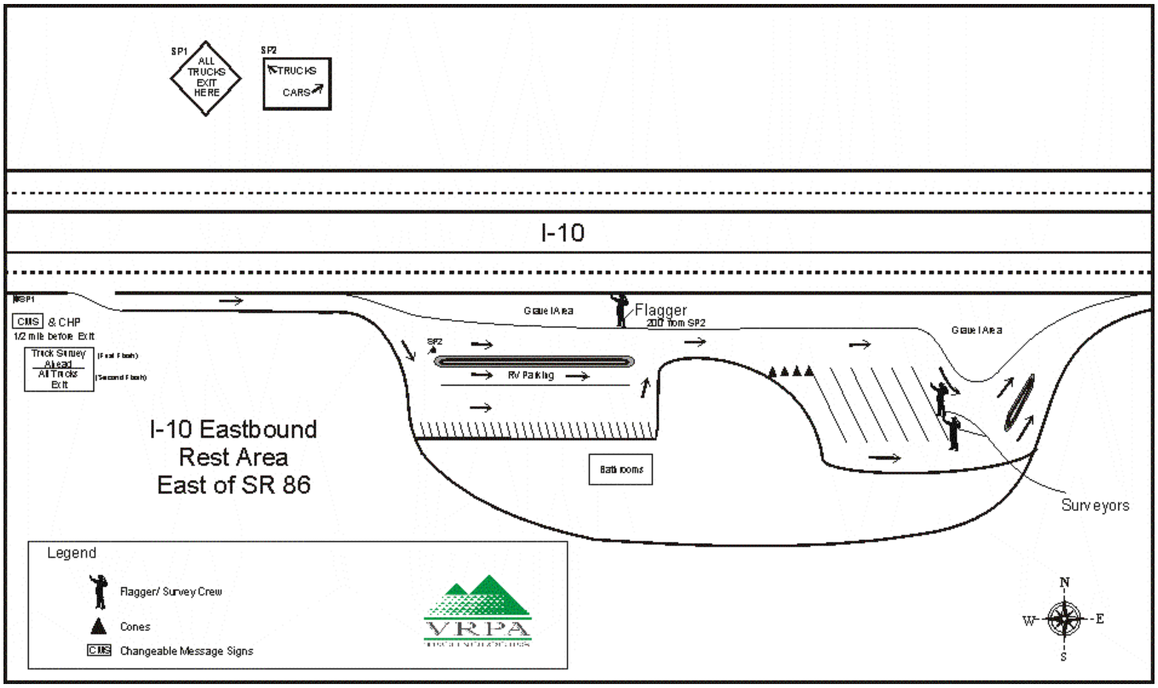

14 FRWY SURVEY AT AVE A
TRUCK SURVEY AHEAD
ALL TRUCKS EXIT AHEAD
ALL TRUCKS EXIT HERE
SEE DETAIL A
CMS
CHP
14 FRWY
SEE DETAIL B
AVE A
TRUCK SURVEY AHEAD
ALL TRUCKS EXIT
ITC BARRICADES, INC.
661-718-8722
TRAFFIC CIRCULATION PLAN

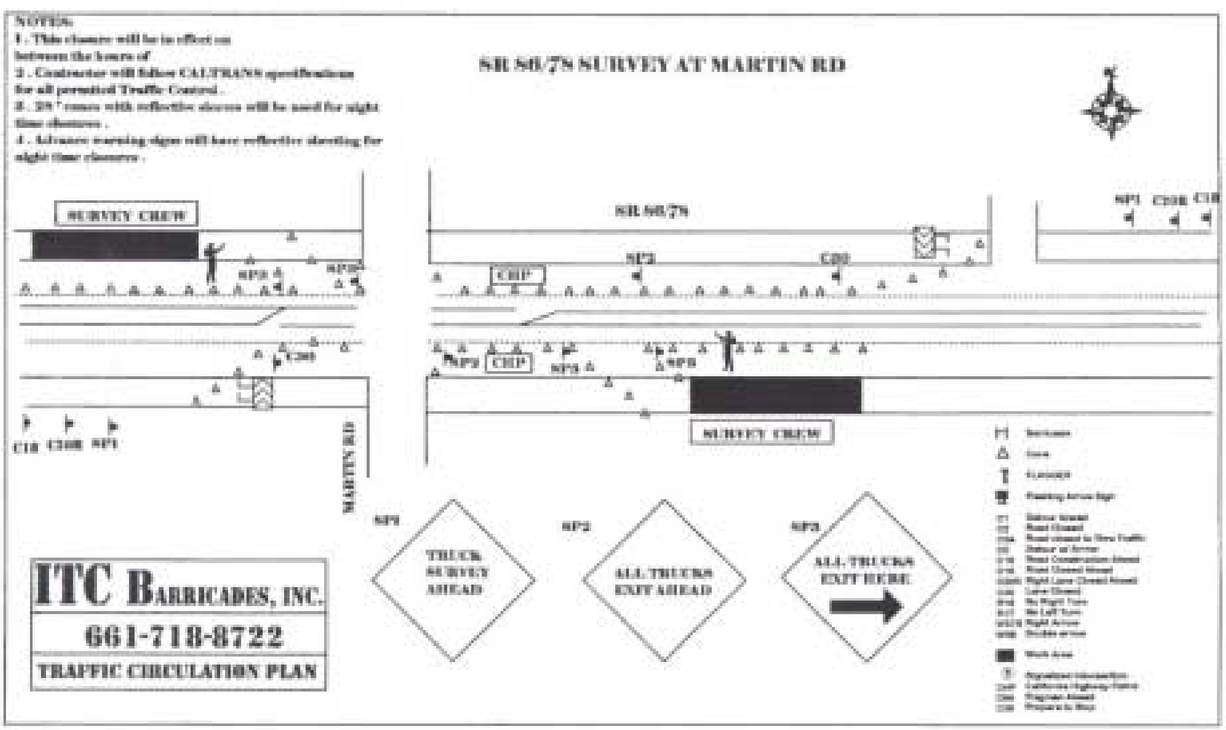

14 FRWY SURVEY AT AVE A
DETAIL A
AVE A
OFF RAMP
SP4
C30
C0A
CHP
SURVEY CREW
ALL TRUCKS
ALL CARS
SP4
N/B 14 FRWY


14 FRWY SURVEY AT AVE A
DETAIL B
N/B 14 FRWY
SURVEY CREW
CHP
C0A
C30
SP4
OFF RAMP
ALL TRUCKS
ALL CARS
SP4
AVE A


SR 58 Westbound
Boron Rest Area
SP1
ALL TRUCKS EXIT HERE
Surveyors
Bathrooms
Existing Sign
Trucks
Cars
Truck Survey Ahead
All Trucks Exit
CMS & CHP
1/2 mile before Exit
Gravel Area
Flagger
250' from car/truck sign
SR 58
SR 58 Eastbound
Boron Rest Area
Legend
Flagger/ Survey Crew
Cones
Changeable Message Signs
VRPA
N
E
S
W


SP1
ALL TRUCKS EXIT HERE
I-15
Flagger
200' from car/truck sign
Surveyors
CMS & CHP
1/2 mile before Exit
Truck Survey Ahead
All Trucks Exit
Trucks
Cars
Existing Sign
I-15 Eastbound
Clyde V. Kane Rest Area
Bathrooms
Legend
Flagger/ Survey Crew
Cones
Changeable Message Signs
VRPA
W
S
N
E


SP1
ALL TRUCKS EXIT HERE
SP2
TRUCKS
CARS
I-10
CMS & CHP
1/2 mile before Exit
Truck Survey Ahead
All Trucks Exit
Flagger
RV Parking
Bathrooms
Surveyors
I-10 Eastbound
Rest Area
East of SR 86
Legend
Flagger/ Survey Crew
Cones
Changeable Message Signs
VRPA
N
W
E
S


NOTES:
1. This closure will be in effect on between the hours of
2. Contractor will follow CALTRANS specifications for all permitted Traffic Control.
3. 28" cones with reflective sleeves will be used for night time closures.
4. Advance warning signs will have reflective sheeting for night time closures.
SR 86/78 SURVEY AT MARTIN RD
SURVEY CREW
SR 86/78
CHP
MARTIN RD
SP1
TRUCK SURVEY AHEAD
SP2
ALL TRUCKS EXIT AHEAD
SP3
ALL TRUCKS EXIT HERE
ITC BARRICADES, INC.
661-718-8722
TRAFFIC CIRCULATION PLAN

APPENDIX F
EXPANSION FACTORS FOR SCAG INTERCEPT SURVEY

Location	Time Period	Axles	Counts	Surveys	Expansion Factor
U.S. 101 North	Early Morning	Two	93	2	46.5
U.S. 101 North	Morning Rush-Hour	Two	412	5	82.4
U.S. 101 North	Mid-Day	Two	523	5	104.6
U.S. 101 North	Evening Rush-Hour	Two	180	1	180.0
U.S. 101 North	Late Evening	Two	55	1	55.0
U.S. 101 North	Early Morning	Three	36	2	18.0
U.S. 101 North	Morning Rush-Hour	Three	66	4	16.5
U.S. 101 North	Mid-Day	Three	91	11	8.3
U.S. 101 North	Evening Rush-Hour	Three	15	3	5.0
U.S. 101 North	Late Evening	Three	0	0	0.0
U.S. 101 North	Early Morning	Four or more	309	42	7.4
U.S. 101 North	Morning Rush-Hour	Four or more	261	29	9.0
U.S. 101 North	Mid-Day	Four or more	535	56	9.6
U.S. 101 North	Evening Rush-Hour	Four or more	223	36	6.2
U.S. 101 North	Late Evening	Four or more	186	49	3.8
U.S. 101 South	Early Morning	Two	54	4	13.5
U.S. 101 South	Morning Rush-Hour	Two	146	11	13.3
U.S. 101 South	Mid-Day	Two	585	14	41.8
U.S. 101 South	Evening Rush-Hour	Two	429	18	23.8
U.S. 101 South	Late Evening	Two	72	3	24.0
U.S. 101 South	Early Morning	Three	9	1	9.0
U.S. 101 South	Morning Rush-Hour	Three	19	6	3.2
U.S. 101 South	Mid-Day	Three	101	15	6.7
U.S. 101 South	Evening Rush-Hour	Three	53	7	7.6
U.S. 101 South	Late Evening	Three	10	4	2.5
U.S. 101 South	Early Morning	Four or more	206	43	4.8
U.S. 101 South	Morning Rush-Hour	Four or more	148	42	3.5
U.S. 101 South	Mid-Day	Four or more	576	96	6.0
U.S. 101 South	Evening Rush-Hour	Four or more	270	40	6.8
U.S. 101 South	Late Evening	Four or	279	52	5.4

		more			
CA 14 North	Early Morning	Two	43	2	21.5
CA 14 North	Morning Rush-Hour	Two	87	4	21.8
CA 14 North	Mid-Day	Two	119	5	23.8
CA 14 North	Evening Rush-Hour	Two	56	6	9.3
CA 14 North	Late Evening	Two	15	1	15.0
CA 14 North	Early Morning	Three	6	6	1.0
CA 14 North	Morning Rush-Hour	Three	7	4	1.8
CA 14 North	Mid-Day	Three	23	5	4.6
CA 14 North	Evening Rush-Hour	Three	8	3	2.7
CA 14 North	Late Evening	Three	0	0	0.0
CA 14 North	Early Morning	Four or more	130	52	2.5
CA 14 North	Morning Rush-Hour	Four or more	86	34	2.5
CA 14 North	Mid-Day	Four or more	288	53	5.4
CA 14 North	Evening Rush-Hour	Four or more	118	39	3.0
CA 14 North	Late Evening	Four or more	122	15	8.1
CA 14 South	Early Morning	Two	18	2	9.0
CA 14 South	Morning Rush-Hour	Two	39	1	39.0
CA 14 South	Mid-Day	Two	144	16	9.0
CA 14 South	Evening Rush-Hour	Two	95	2	47.5
CA 14 South	Late Evening	Two	13	1	13.0
CA 14 South	Early Morning	Three	1	1	1.0
CA 14 South	Morning Rush-Hour	Three	12	3	4.0
CA 14 South	Mid-Day	Three	21	6	3.5
CA 14 South	Evening Rush-Hour	Three	9	2	4.5
CA 14 South	Late Evening	Three	1	1	1.0
CA 14 South	Early Morning	Four or more	202	38	5.3
CA 14 South	Morning Rush-Hour	Four or more	115	43	2.7
CA 14 South	Mid-Day	Four or more	231	75	3.1
CA 14 South	Evening Rush-Hour	Four or more	142	50	2.8
CA 14 South	Late Evening	Four or more	124	9	13.8
CA 58 East	Early Morning	Two	0	0	0.0
CA 58 East	Morning Rush-Hour	Two	0	0	0.0
CA 58 East	Mid-Day	Two	78	1	78.0

CA 58 East	Evening Rush-Hour	Two	85	1	85.0
CA 58 East	Late Evening	Two	0	0	0.0
CA 58 East	Early Morning	Three	3	1	3.0
CA 58 East	Morning Rush-Hour	Three	27	1	27.0
CA 58 East	Mid-Day	Three	0	0	0.0
CA 58 East	Evening Rush-Hour	Three	0	0	0.0
CA 58 East	Late Evening	Three	6	1	6.0
CA 58 East	Early Morning	Four or more	618	69	9.0
CA 58 East	Morning Rush-Hour	Four or more	433	63	6.9
CA 58 East	Mid-Day	Four or more	1000	187	5.3
CA 58 East	Evening Rush-Hour	Four or more	735	109	6.7
CA 58 East	Late Evening	Four or more	619	99	6.3
CA 58 West	Early Morning	Two	0	0	0.0
CA 58 West	Morning Rush-Hour	Two	0	0	0.0
CA 58 West	Mid-Day	Two	156	4	39.0
CA 58 West	Evening Rush-Hour	Two	0	0	0.0
CA 58 West	Late Evening	Two	0	0	0.0
CA 58 West	Early Morning	Three	5	5	1.0
CA 58 West	Morning Rush-Hour	Three	0	0	0.0
CA 58 West	Mid-Day	Three	10	6	1.7
CA 58 West	Evening Rush-Hour	Three	5	1	5.0
CA 58 West	Late Evening	Three	0	0	0.0
CA 58 West	Early Morning	Four or more	351	65	5.4
CA 58 West	Morning Rush-Hour	Four or more	240	24	10.0
CA 58 West	Mid-Day	Four or more	606	86	7.0
CA 58 West	Evening Rush-Hour	Four or more	445	72	6.2
CA 58 West	Late Evening	Four or more	423	62	6.8
I-15 East	Early Morning	Two	0	0	0.0
I-15 East	Morning Rush-Hour	Two	64	1	64.0
I-15 East	Mid-Day	Two	102	2	51.0
I-15 East	Evening Rush-Hour	Two	0	0	0.0
I-15 East	Late Evening	Two	93	3	31.0
I-15 East	Early Morning	Three	6	1	6.0
I-15 East	Morning Rush-Hour	Three	7	1	7.0

I-15 East	Mid-Day	Three	15	5	3.0
I-15 East	Evening Rush-Hour	Three	8	3	2.7
I-15 East	Late Evening	Three	16	1	16.0
I-15 East	Early Morning	Four or more	772	60	12.9
I-15 East	Morning Rush-Hour	Four or more	396	67	5.9
I-15 East	Mid-Day	Four or more	719	96	7.5
I-15 East	Evening Rush-Hour	Four or more	650	83	7.8
I-15 East	Late Evening	Four or more	641	74	8.7
I-10 East	Early Morning	Two	62	2	31.0
I-10 East	Morning Rush-Hour	Two	76	2	38.0
I-10 East	Mid-Day	Two	51	1	51.0
I-10 East	Evening Rush-Hour	Two	0	0	0.0
I-10 East	Late Evening	Two	0	0	0.0
I-10 East	Early Morning	Three	25	3	8.3
I-10 East	Morning Rush-Hour	Three	7	2	3.5
I-10 East	Mid-Day	Three	18	1	18.0
I-10 East	Evening Rush-Hour	Three	14	2	7.0
I-10 East	Late Evening	Three	0	0	0.0
I-10 East	Early Morning	Four or more	835	66	12.7
I-10 East	Morning Rush-Hour	Four or more	346	83	4.2
I-10 East	Mid-Day	Four or more	849	155	5.5
I-10 East	Evening Rush-Hour	Four or more	852	69	12.3
I-10 East	Late Evening	Four or more	1140	85	13.4
SR 86 North	Early Morning	Two	20	1	20.0
SR 86 North	Morning Rush-Hour	Two	20	1	20.0
SR 86 North	Mid-Day	Two	52	4	13.0
SR 86 North	Evening Rush-Hour	Two	18	1	18.0
SR 86 North	Late Evening	Two	8	2	4.0
SR 86 North	Early Morning	Three	0	0	0.0
SR 86 North	Morning Rush-Hour	Three	3	2	1.5
SR 86 North	Mid-Day	Three	9	1	9.0
SR 86 North	Evening Rush-Hour	Three	5	5	1.0
SR 86 North	Late Evening	Three	8	5	1.6
SR 86 North	Early Morning	Four or	139	39	3.6

		more			
SR 86 North	Morning Rush-Hour	Four or more	147	28	5.3
SR 86 North	Mid-Day	Four or more	370	45	8.2
SR 86 North	Evening Rush-Hour	Four or more	126	43	2.9
SR 86 North	Late Evening	Four or more	115	40	2.9
SR 86 South	Early Morning	Two	0	0	0.0
SR 86 South	Morning Rush-Hour	Two	0	0	0.0
SR 86 South	Mid-Day	Two	133	1	133.0
SR 86 South	Evening Rush-Hour	Two	0	0	0.0
SR 86 South	Late Evening	Two	0	0	0.0
SR 86 South	Early Morning	Three	0	0	0.0
SR 86 South	Morning Rush-Hour	Three	0	0	0.0
SR 86 South	Mid-Day	Three	34	5	6.8
SR 86 South	Evening Rush-Hour	Three	0	0	0.0
SR 86 South	Late Evening	Three	0	0	0.0
SR 86 South	Early Morning	Four or more	196	42	4.7
SR 86 South	Morning Rush-Hour	Four or more	146	39	3.7
SR 86 South	Mid-Day	Four or more	288	51	5.6
SR 86 South	Evening Rush-Hour	Four or more	191	37	5.2
SR 86 South	Late Evening	Four or more	166	46	3.6